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VOLUME 2

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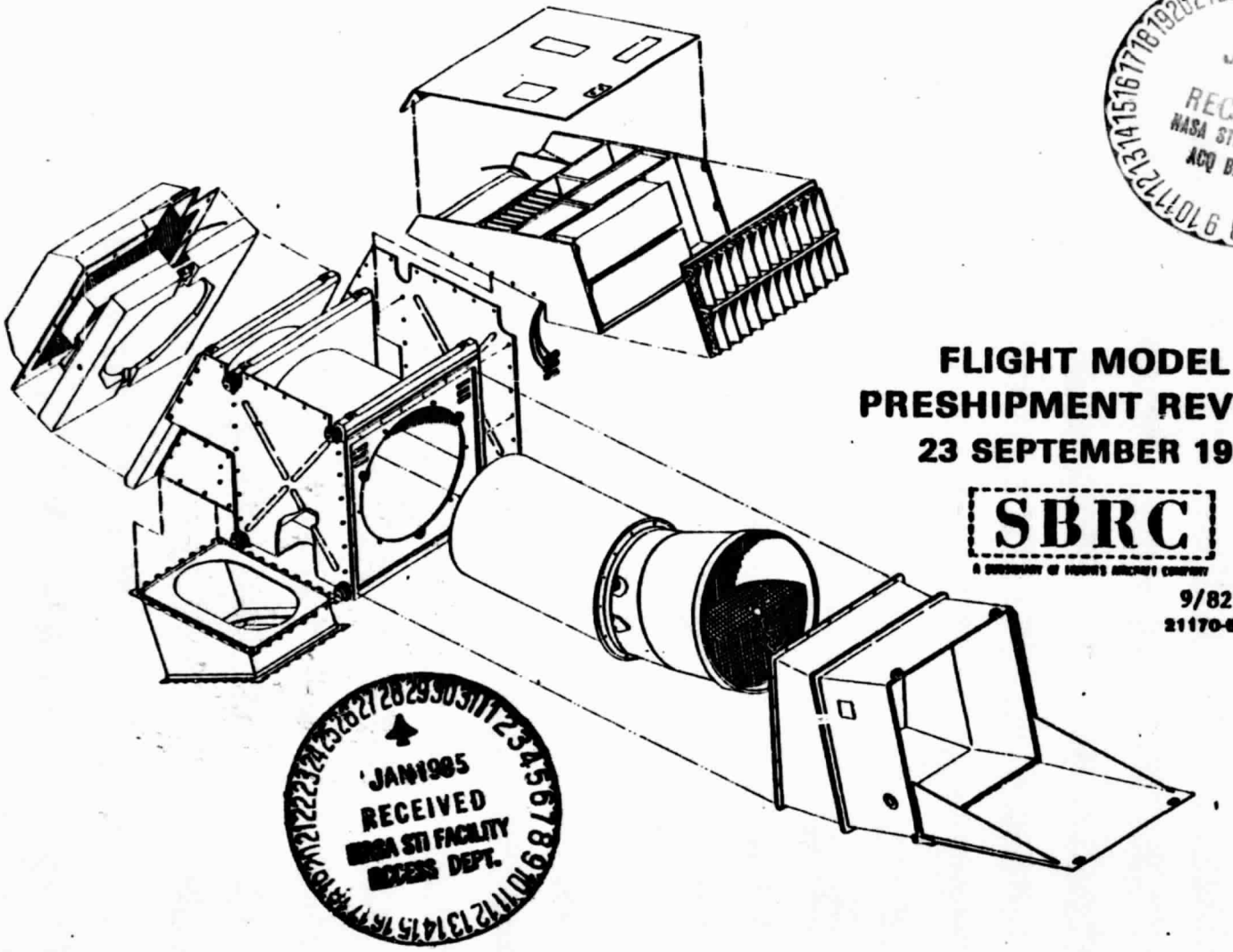
THEMATIC MAPPER



FLIGHT MODEL PRESHIPMENT REVIEW

23 SEPTEMBER 1982

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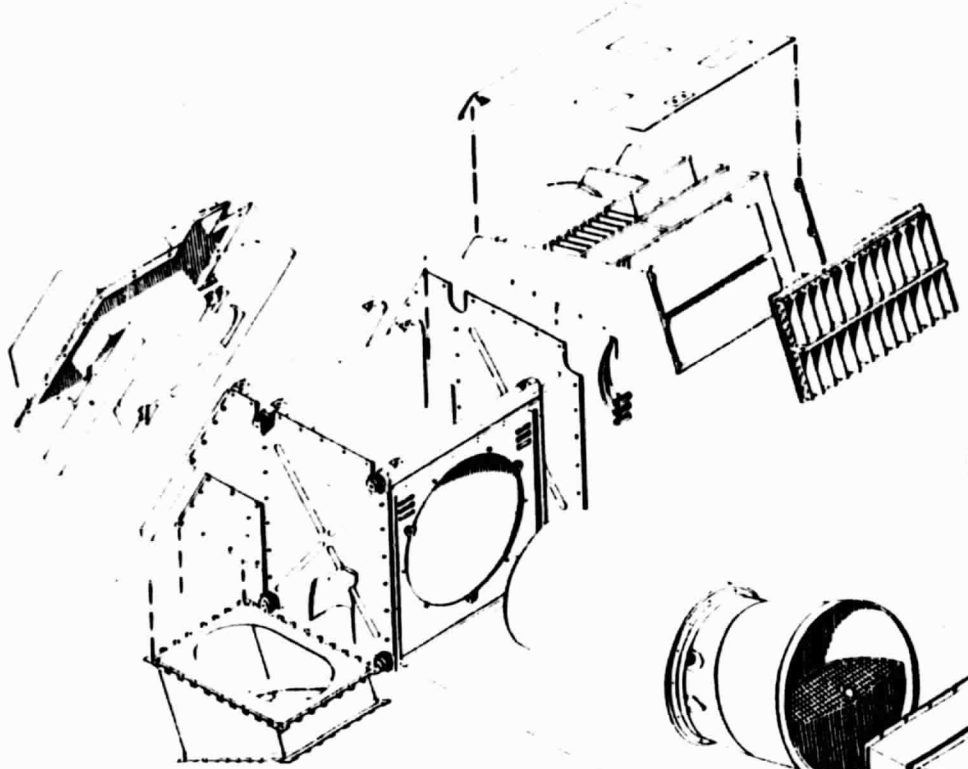
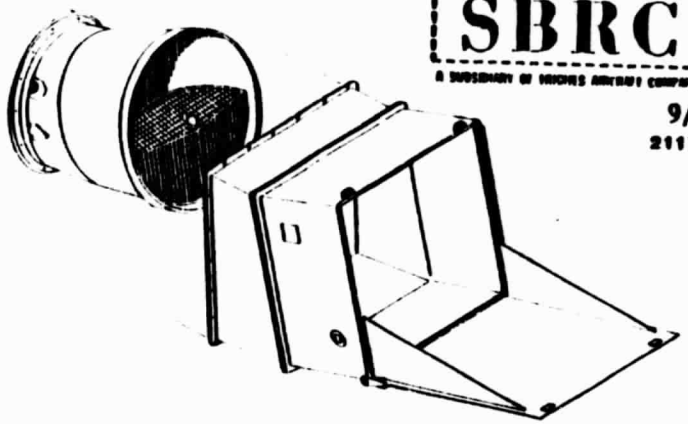
THEMATIC MAPPER





FLIGHT MODEL
PRESHIPMENT REVIEW
23 SEPTEMBER 1982

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AGENDA

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23 SEPTEMBER 1982

TIME	TOPIC	SPEAKER
0830	PROGRAM OVERVIEW	F R PHILLIPS
0900	MULTIPLEXER ASSY	R L JULIAN
0915	POWER SUPPLY ASSY	G C GENSON
0930	SCAN MIRROR ASSY	A B MARCHANT
0945	ELECTRONICS MODULE	N CURRENT
1030	BREAK	
1000	FOCAL PLANE ASSY	D M RANDALL

AGENDA (cont.)

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23 SEPTEMBER 1982

TIME	TOPIC	SPEAKER
1015	RADIOMETER	J C KODAK
	MAIN FRAME	
	AFT OPTICS	
	RELAY OPTICS	
	RADIATION COOLER	
1030	BREAK	
1045	SYSTEMS TEST	G PLEWS
1100	SYSTEMS PERFORMANCE	J L ENGEL
1200	LUNCH	
1330	SYSTEM PERFORMANCE (CONTINUE)	J L ENGEL
1645	SUMMARY	F R PHILLIPS

24 SEPTEMBER 1982

SPLINTER SESSIONS AS REQUIRED
DISPOSITION OF ACTION ITEMS

REVIEW PURPOSE

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TO REVIEW AVAILABLE DATA AND ORGANIZE FOR MANAGEMENT DECISION

- COMPARE MEASURED TO SPECIFIED PERFORMANCE
- DESCRIBE TEST METHOD AND SEQUENCE
- REPORT FAILURES AND LIENS

ORGANIZATION

THEMATIC MAPPER PROGRAM

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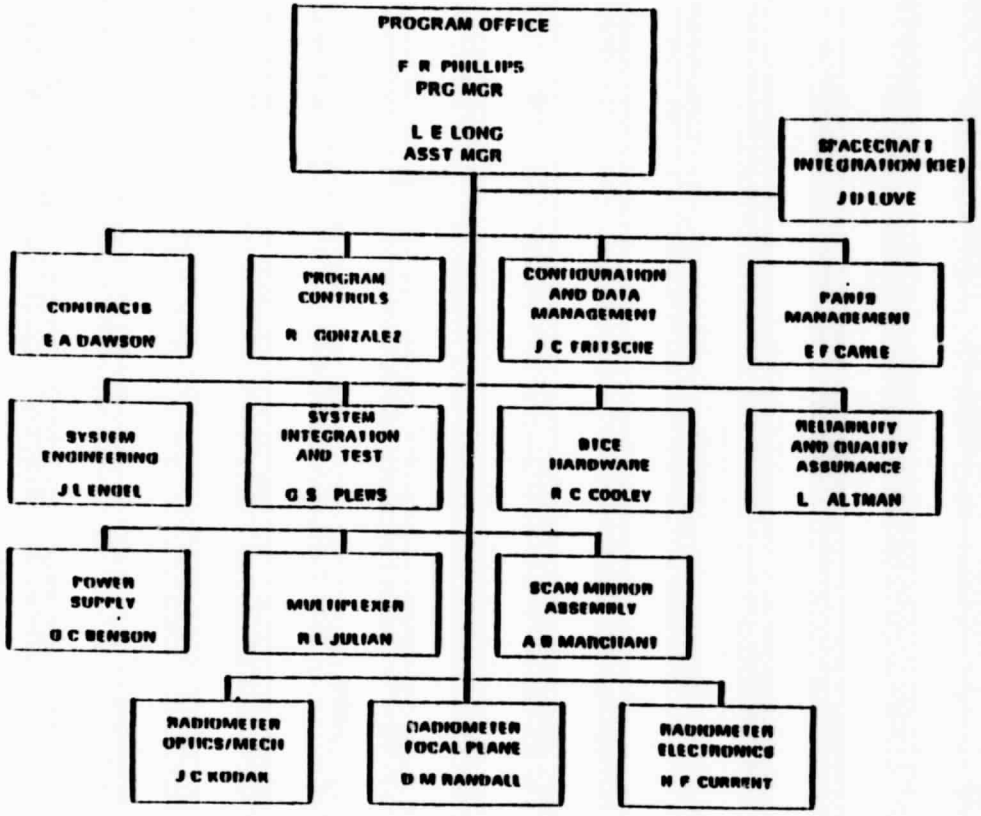

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MULTIPLEXER PERFORMANCE

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MULTIPLEXER

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- FUNCTIONS AND REQUIREMENTS
- DESIGN
- TESTING PROGRAM & DISCREPANCY HISTORY
- FLIGHT UNIT PERFORMANCE
- WAIVERS, DEVIATIONS, & RELIABILITY

THEMATIC MAPPER MULTIPLEXER

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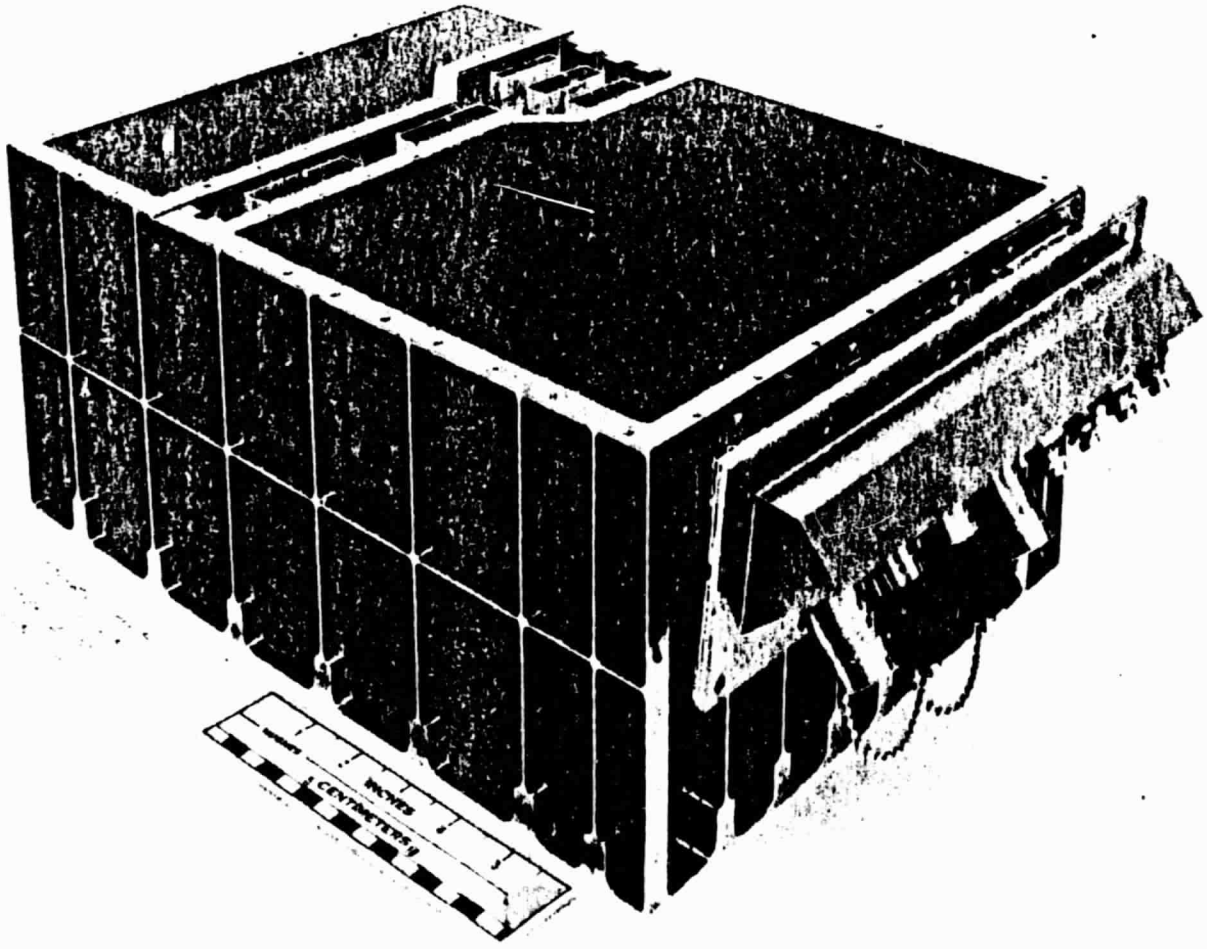

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MULTIPLEXER FUNCTIONS

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SENSOR SIGNAL PROCESSING (100 SENSORS)

FORMATTING AND ENCODING

- SENSOR DATA
- TELEMETRY DATA
- SPACECRAFT TIME CODE
- LINE LENGTH CODE

INSTRUMENT TIMING AND SYNCHRONIZATION

MULTIPLEXER REQUIREMENTS

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- 100 INPUTS

  DIFFERENTIAL 52 KHZ

- DC RESTORE ± 0.06%, τ = 6.5 ±2 MSEC

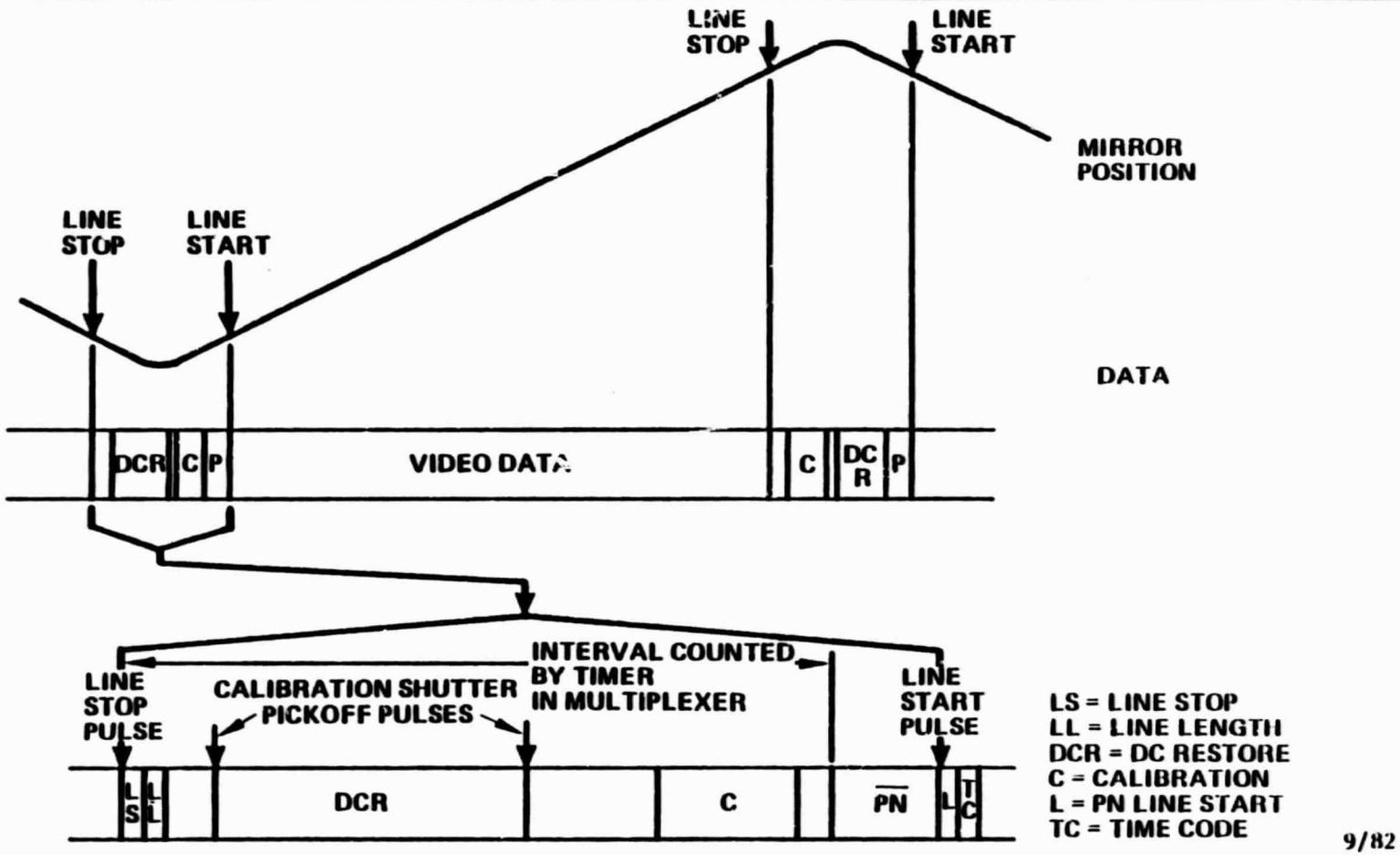
- THRESHOLD ACCURACY

  ±½ LSB RMS

- BASEPLATE TEMP 50°C MAX DESIGN

- 85 MBIT PN CODED OUTPUT

DATA FORMAT DURING SCAN



LS = LINE STOP
LL = LINE LENGTH
DCR = DC RESTORE
C = CALIBRATION
L = PN LINE START
TC = TIME CODE

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MINOR FRAME FORMAT

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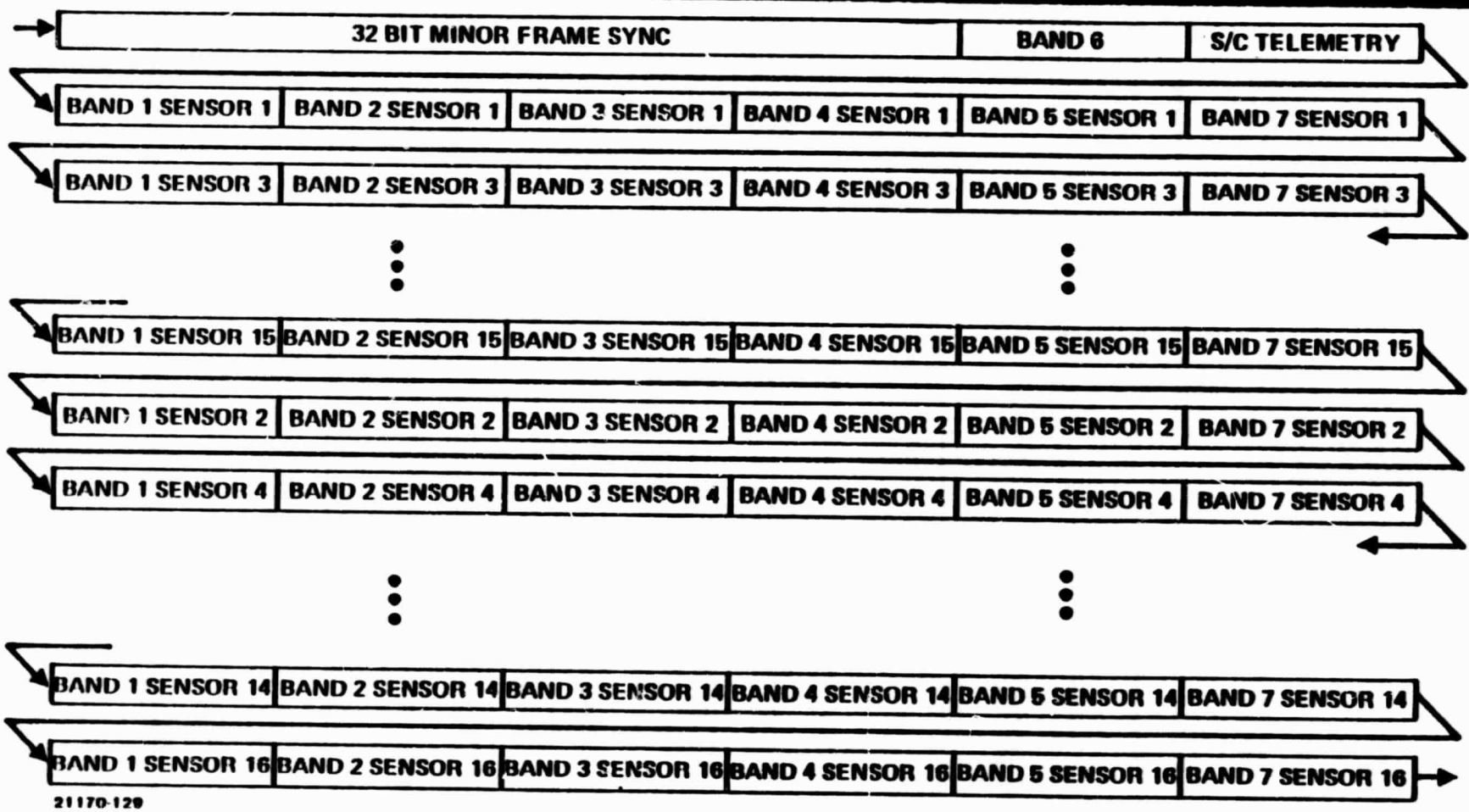

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MULTIPLEXER

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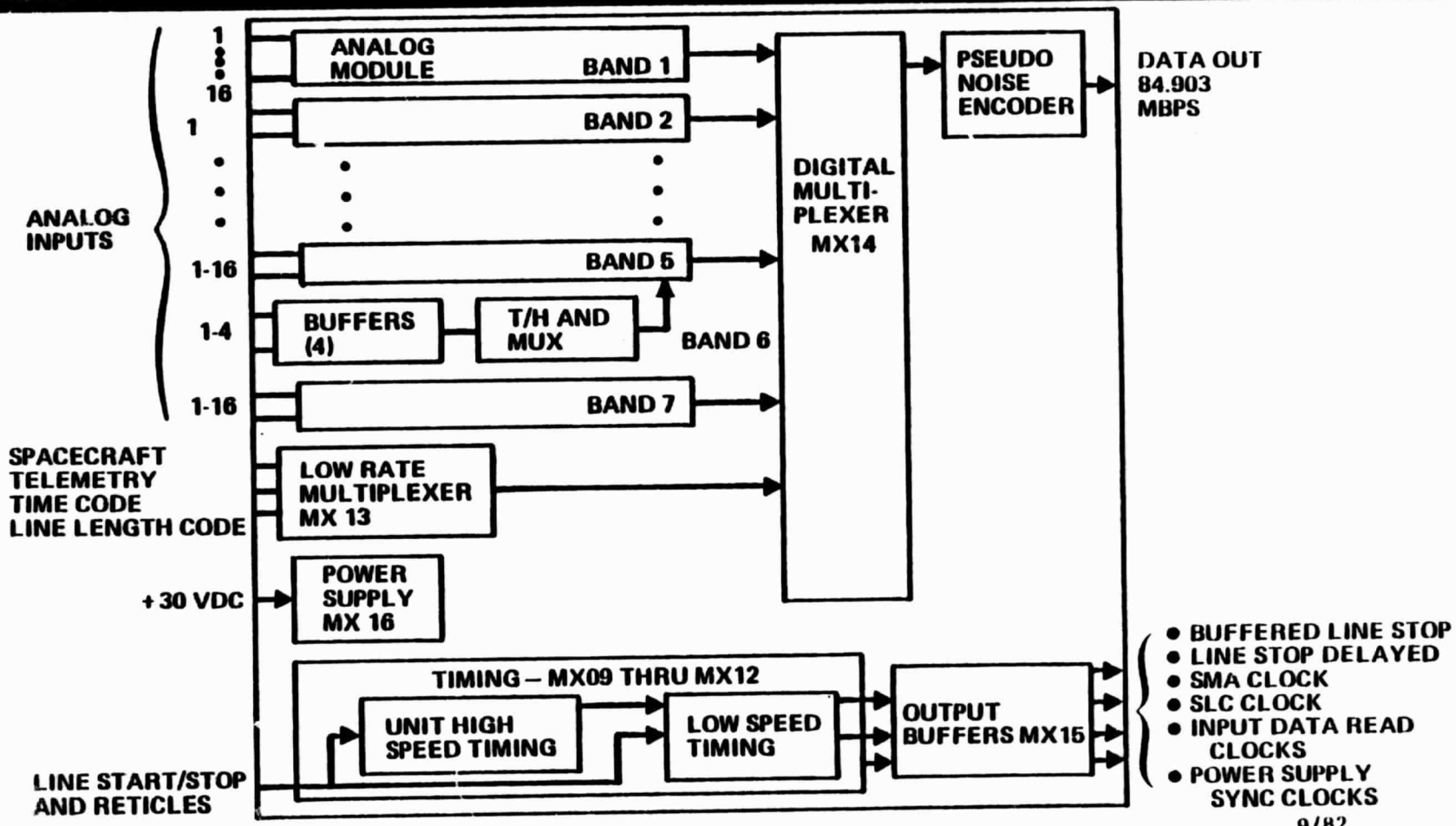

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MULTIPLEXER CHARACTERISTICS

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- SIZE = 14.0 IN. L BY 10.4 IN. W (MOUNTING SURFACE) BY 6.9 IN. H
- WEIGHT = 27.5 LB
- POWER = 117.1 W AT 30.0 V INPUT
- MODULAR WITH PLUG-IN MODULES AND WIRE WRAP INTERCONNECT
- MULTIPLE USE HYBRID MICROCIRCUITS FOR ANALOG FUNCTIONS
- STANDARD LOGIC FAMILIES (ECL 10,000; 54S; 54LS)
- UNREGULATED POWER SUPPLY – MULTIPLEXER GETS REGULATED INPUT FROM INSTRUMENT SUPPLY

UNIT TEST

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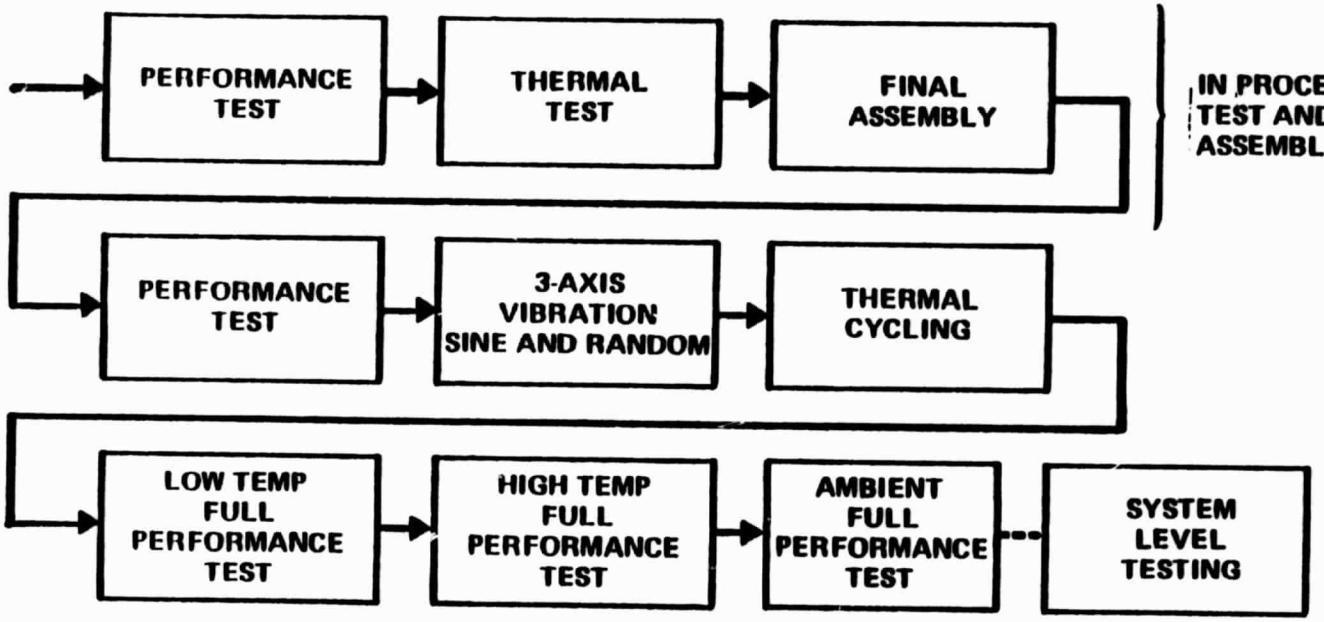
COMPUTERIZED TEST STATION

- PROVIDES INPUTS
- MONITORS AND ANALYZES OUTPUTS
- CONDUCTS AUTOMATED AND MANUAL TESTING

TESTS VERIFY

- SIGNAL PROCESSING PERFORMANCE ACCURACY
- INPUT/OUTPUT LEVELS, FORMATS
- POWER DISSIPATION
- ENVIRONMENTAL RESPONSE

PROTOFLIGHT MULTIPLEXER TEST SEQUENCE



MULTIPLEXER FUNCTIONAL TEST

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POWER SUPPLY AND TELEMETRY STATUS (LOW, NOMINAL, HIGH BUS)
- INPUT CURRENT
- SECONDARY VOLTAGES
- ALL TELEMETRY

SERIAL DATA FORMAT TEST

(AUTOMATED CHECK)
- PN CODE
- SYNC PATTERN
- TIME CODE
- SPACECRAFT TELEMETRY
- MAJOR FRAME COUNT
- RETICLE PATTERN
- LINE STOP
- LINE LENGTH CODE
- $\overline{PN}$

INPUT BUFFER TEST
- DC GAIN
- FREQUENCY RESPONSE
- DC RESTORE τ
- DC RESTORE ACCURACY
- DROOP RATE

A/D CONVERSION

ALL 100 CHANNELS

CROSSTALK

ALL CHANNEL PAIRS

OUTPUT SIGNAL WAVESHAPES AND TIMING

INPUT SIGNAL LEVELS

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SIGNAL PROCESSING PERFORMANCE

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PARAMETER	SPECIFICATION	FLIGHT PERFORMANCE
SAMPLE RATE	104.04×10^3/SEC ± 0.1%	104.035 KHZ
3 dB FREQUENCY	300 KHZ ≤ f ≤ 800 KHZ	ALL PASS
DC RESTORE ACCURACY	±2.5 MV MAX	±1.4 mV
DC RESTORE τ	6.5 ± 2.0 MSEC	5.1 MS TO 6.5 MS
CROSSTALK	-46 dB OR BETTER	64 OF 4550 TESTS MARGINAL
A/D CONVERTER THRESHOLD ACCURACY	ϵ = 7.82 MV RMS MAX	3.399 MV ≤ ϵ ≤ 5.431 MV
COMMON MODE REJECTION RATIO	30 dB MIN	ALL CHANNELS PASS 44 dB MIN MEASURED AT HYBRID LEVEL
DC RESTORE DROOP RATE	≤3.3 MV/SEC AT 25°	2 SENSORS > 3.3 MV/SEC HIGHEST VALUE = 5.04 MV/SEC

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HYBRID TESTING

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- MAX PRACTICAL BOND PULL TEST
- INITIAL TRIMMING AND CHECKOUT
- PRESEAL INSPECTION BY HYBRIDS LAB, HUGHES SOURCE*, USAF*
- LEAK TESTING, P.I.N. TESTING
- 1500 G SHOCK
- BURN-IN* AT 125°C FOR 2 PERIODS OF 168 HRS
- ALL PERFORMANCE TESTS INCLUDE TEMPERATURE TESTING AT -5°C, +25°C, AND +80°C

* = PF, F1 HYBRIDS ONLY

MULTIPLEXER HYBRID RELIABILITY

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HYBRID		USE PER MUX	HYBRIDS REMOVED AT S/A TEST LEVEL					HYBRIDS REMOVED AT UNIT TEST LEVEL				
PART NO.	FUNCTION		PRIMARY	INDUCED	NO FAILURE	UNKNOWN	TOTAL	PRIMARY	INDUCED	NO FAILURE	UNKNOWN	TOTAL
3905969	ANALOG INPUT BUFFER	25	3	2	1	1	7			6		6
3905973	ANALOG MULTIPLEXER	13	1	1	1		3		1	1	(2)	4
3905977	A/D CONVERTER	6				(1)	1					0

- ALL VERIFIED FAILURES (EXCEPT 1 INDUCED FAILURE) DETECTED AT INITIAL SUBASSEMBLY POWER TURN-ON. HYBRIDS DO NOT FAIL DUE TO USE

FLIGHT MULTIPLEXER FR's

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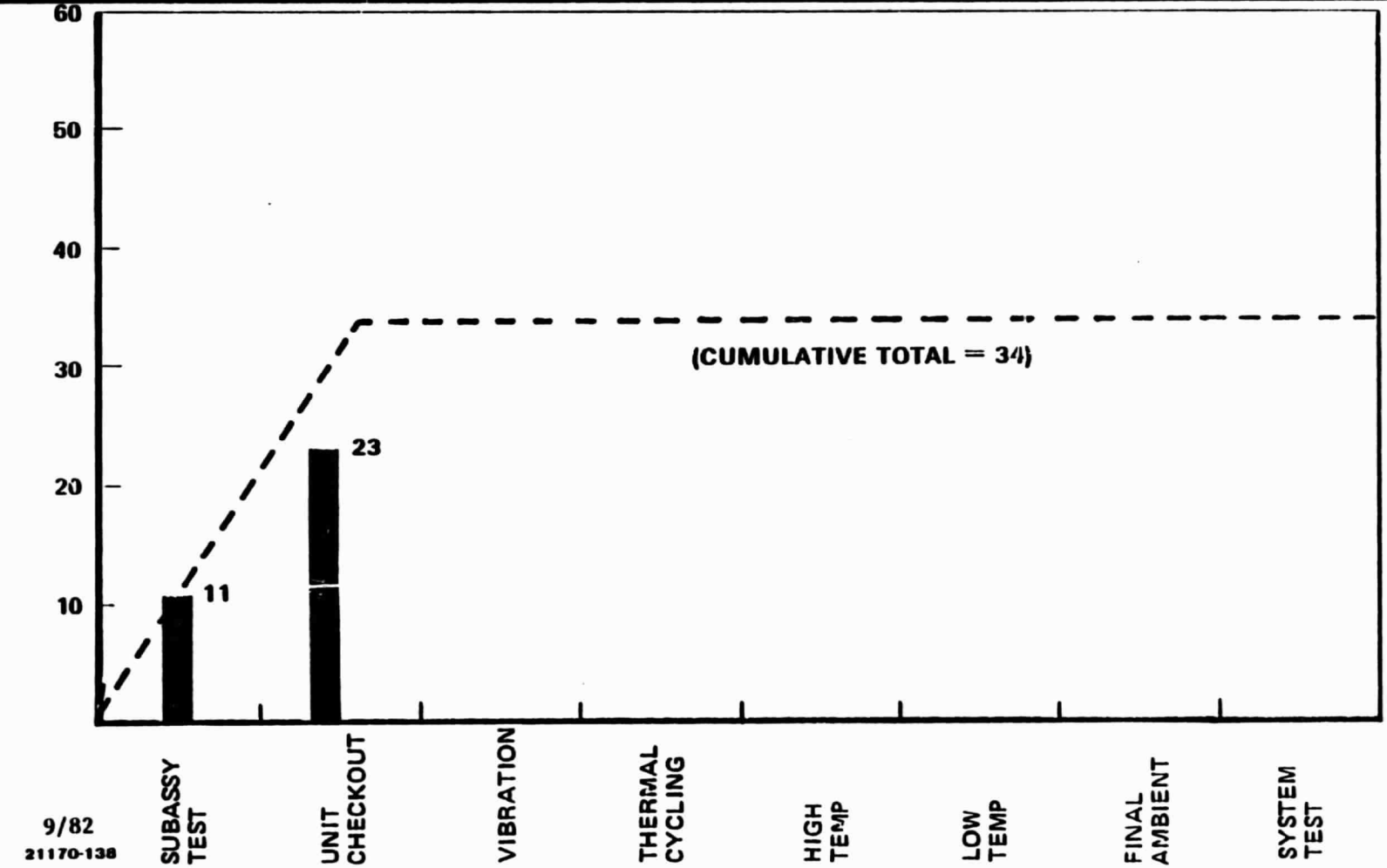

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MULTIPLEXER WAIVERS AND DEVIATIONS

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- DEVIATIONS (SIX) TO ALLOW USE OF ALTERNATE WIRING ON BOARDS
- WAIVER TO USE UNIT WITH ONE MOUNTING HOLE BLOCKED BY BROKEN SCREW
- WAIVER OF MINOR PERFORMANCE DISCREPANCIES
  - CROSSTALK ON 16 SENSOR PAIRS EXCEEDS SPECIFICATION
  - 2 CHANNELS EXCEDE SELF IMPOSED DC RESTORE DROOP RATE
  - 6 SENSORS EXHIBIT 1 A / D STEP OUTSIDE SPECIFIED RANGE (NOISE IS IN SPEC ON ALL SENSORS)

POWER SUPPLY PERFORMANCE

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FLIGHT MODEL POWER SUPPLY GENERAL OPERATING AND PHYSICAL CHARACTERISTICS

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SIZE: 13.3 IN. (L) x 6.5 IN. (H) x 5.8 IN. (W)

WEIGHT: 23.0 LB

POWER DISSIPATION: 113 W, MAX

CHARACTERISTICS

CONVERTER:
- DC-TO-DC CONVERTER UTILIZING PULSE-WIDTH-MODULATION TO REGULATE OUTPUT
- SWITCHING FREQUENCY 104 KHz (SYNCHRONIZED)
- INCORPORATES FAULT PROTECTION; UNDERVOLTAGE, OVERVOLTAGE, OVERCURRENT, AND OVERTEMPERATURE

INPUT: 23 V TO 35 V

OUTPUT: 24 VOLTAGE OUTPUTS WITH ISOLATED RETURNS (TABLE I)

REDUNDANCY: FULLY REDUNDANT POWER SUPPLIES WITHIN ONE UNIT

EFFICIENCY: 70% MIN IN PICTURE MODE (265 W OUTPUT)

FLIGHT MODEL POWER SUPPLY
PERFORMANCE VS SPECIFICATION

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OUTPUT VOLTAGE REGULATION

- MUX OUTPUT USED FOR FEEDBACK CONTROL
- MAINTAIN REGULATION DURING PICTURE MODE OPERATION WITH VARIATIONS IN INPUT VOLTAGE FROM 23 TO 35 V AND TEMPERATURE FROM $0^{o}C$ TO $55^{o}C$

PERFORMANCE		SPECIFICATION
PS 1	2.1%	LIMITS DEFINED IN TABLE I (GENERALLY 10%)
PS 2	1.0%	

OUTPUT VOLTAGE RIPPLE

- TYPICALL 0.05% USiNG LOW PASS FILTER WITH 220 kHz OUT-OFF

$\leqslant 3\%$

OUTPUT LOADS

- TEST LOADS AND MAXIMUM LOADS DEFINED IN TABLE I
- SYSTEM TESTS LOADS FOUND TO BE IN AGREEMENT WITH UNIT TESTS LOADS

FLIGHT MODEL POWER SUPPLY (cont.)

PERFORMANCE VS SPECIFICATION

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EFFICIENCY

- PICTURE MODE EFFICIENCY WHEN OUTPUT POWER 265 W OUTPUT

PERFORMANCE:

TEMP	EFFICIENCY % BUS VOLTAGE (PRIMARY/REDUNDANT)		
	23 V	28 V	35 V
AMBIENT	75.2 / 75.3	74.4 / 74.8	73.2 / 73.1
$0^{o}C$	75.9 / 76.2	75.4 / 75.3	73.7 / 73.4
$55^{o}C$	74.0 / 74.4	73.9 / 74.2	72.4 / 72.6

SPECIFICATION $\geq$ 70% IN PICTURE MODE

IMPEDANCE BETWEEN RETURNS

- IMPEDANCES BETWEEN RETURNS MET IN ALL CASES AS DEFINED IN TABLE II

FLIGHT MODEL POWER SUPPLY (cont.) PERFORMANCE VS SPECIFICATION

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TURN-ON REQUIREMENTS (COLD TEMP START-UP)

- INITIAL TURN-ON INTO INTERNAL STANDBY, APPROXIMATELY 42 W, AT BUS VOLTAGE OF 23 V AND TEMP OF -25°C
- SYSTEM ALLOWED TO WARM UP TO 0°C
- SYSTEM COMMANDED "ON" INTO FULL PICTURE MODE AND SYNCHRONIZED TO MULTIPLEXER
- BOTH PRIMARY AND REDUNDANT POWER SUPPLIES MEET REQUIREMENT AS DEMONSTRATED DURING UNIT TEST AND SUBSEQUENT INSTRUMENT LEVEL ENVIRONMENTAL TESTS

TURN-ON TRANSIENTS

- IN-RUSH CURRENT

PERFORMANCE	SPECIFICATION
15.0 A PEAK AT 35 VDC FOR FIRST 10 = SEC (WAIVER W-101)	10.0 A PEAK AT 35 VDC FOR FIRST 10 μSEC

FLIGHT MODEL POWER SUPPLY (cont.)

PERFORMANCE VS SPECIFICATION

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TURN-OFF TRANSIENTS

- OVERVOLTAGE RING AT TURN-OFF

PERFORMANCE	SPECIFICATION
COMPLIES-TRANSIENT SUPPRESSION CIRCUITRY	INPUT VOLTAGE SHALL NOT EXCEED 45 V OR -2 VOLTS

TELEMETRY

- OUTPUT VOLTAGE TELEMETRY REMAINS WITHIN DYNAMIC RANGE 0 TO 5.1 V WITH THE FOLLOWING EXCEPTIONS:

SMA + 7 V RADIOMETER LOGIC CDVU OUTGAS HTR	OUTPUT TELEMETRY VOLTAGES EXCEED 5.1 V IN OPEN CIRCUIT CONFIGURATION RESULTING IN SATURATED DATA CHANNEL. LOSS OF DATA IN OPEN CIRCUIT CONFIGURATION JUDGED ACCEPTABLE
INPUT CURRENT	INPUT CURRENT TELEMETRY CHARACTERISTIC UNRELIABLE IN MEASUREMENT OF INPUT CURRENT. TM CIRCUITRY SUSCEPTABLE TO NOISE WITHIN POWER SUPPLY (FIGURE 1)

OVERVOLTAGE PROTECTION

- POWER SUPPLY DESIGNED TO TURN-OFF IN OVERVOLTAGE IF INPUT BUS EXCEEDS SELECTED MAXIMUM VALUE

PERFORMANCE:

TEMP	OVERVOLTAGE BUS VOLTAGE (PRIMARY/REDUNDANT)		
	23 V	28 V	35 V
AMBIENT	38.5/38.8	37.8/38.8	38.4/38.9
0°C	38.1/39.0	38.1/39.1	38.5/39.0
55°C	38.3/38.5	38.2/38.8	38.2/38.8

SPECIFICATION: 38 ± 2 V

OVERTEMPERATURE PROTECTION

- PHASES BACK MAXI-SWITCHER FOR MIN OF 60 SEC IF TEMP AT POWER SUPPLY INTERFACE EXCEEDS SELECTED MAX VALUE

PERFORMANCE:

UNIT LEVEL — $40^{o} \pm 3^{o}C$ AT INTERFACE*
$45 \pm 3^{o}C$ AT THERMISTOR AND > 60 SEC DELAY*

SPECIFICATION: $40^{o} \pm 3^{o}C$ AT INTERFACE AND > 60 SEC DELAY

*DEMONSTRATED AT TEST AND INSTRUMENT LEVEL ENVIRONMENTAL TEST

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FLIGHT MODEL POWER SUPPLY PERFORMANCE VS SPECIFICATION

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FLIGHT MODEL POWER SUPPLY PERFORMANCE VS SPECIFICATION (cont.)

UNDERVOLTAGE PROTECTION

- DRIVE TO MAXI AND MINI SWITCHER REMOVED WHEN INPUT VOLTAGE DROPS BELOW SELECTED MINIMUM VALUE

PERFORMANCE:

	UNDERVOLTAGE (ON TO OFF)* BUS VOLTAGE (PRIMARY/REDUNDANT)		
TEMP	23 V	28 V	35 V
AMBIENT	18.0/18.0	18.1/18.0	18.1/18.1
0°C	18.1/18.1	18.1/18.0	18.1/18.0
55°C	18.00/18.00	18.1/18.1	18.1/18.1

*OFF TO ON VOLTAGE APPROXIMATELY 19.0 VOLTS

SPECIFICATION: 19 ± 1 V

INPUT CURRENT LIMIT PROTECTION

- PHASES BACK MAX SWITCHER TO LIMIT INPUT CURRENT

PERFORMANCE: PRIMARY 15.96 AT 28.0 V, AMBINET TEMP.
REDUNDANT 17.20A AT 28.0 V, AMBIENT TEMP.

SPECIFICATION: 25 A MAX

FLIGHT MODEL POWER SUPPLY DEVELOPMENT SCHEDULE

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UNIT ASSEMBLY → WIRE CHECK AND INSPECTION → INITIAL PERFORMANCE TEST AND RESISTOR SELECT → THERMAL CYCLING

PREACCEPTANCE INSPECTION → VIBRATION (RANDOM) → THERMAL CYCLING (7 CYCLES)

FINAL UNIT BUY-OFF → INTEGRATION TESTS

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FLIGHT MODEL POWER SUPPLY FAILURE REPORT OCCURRENCES

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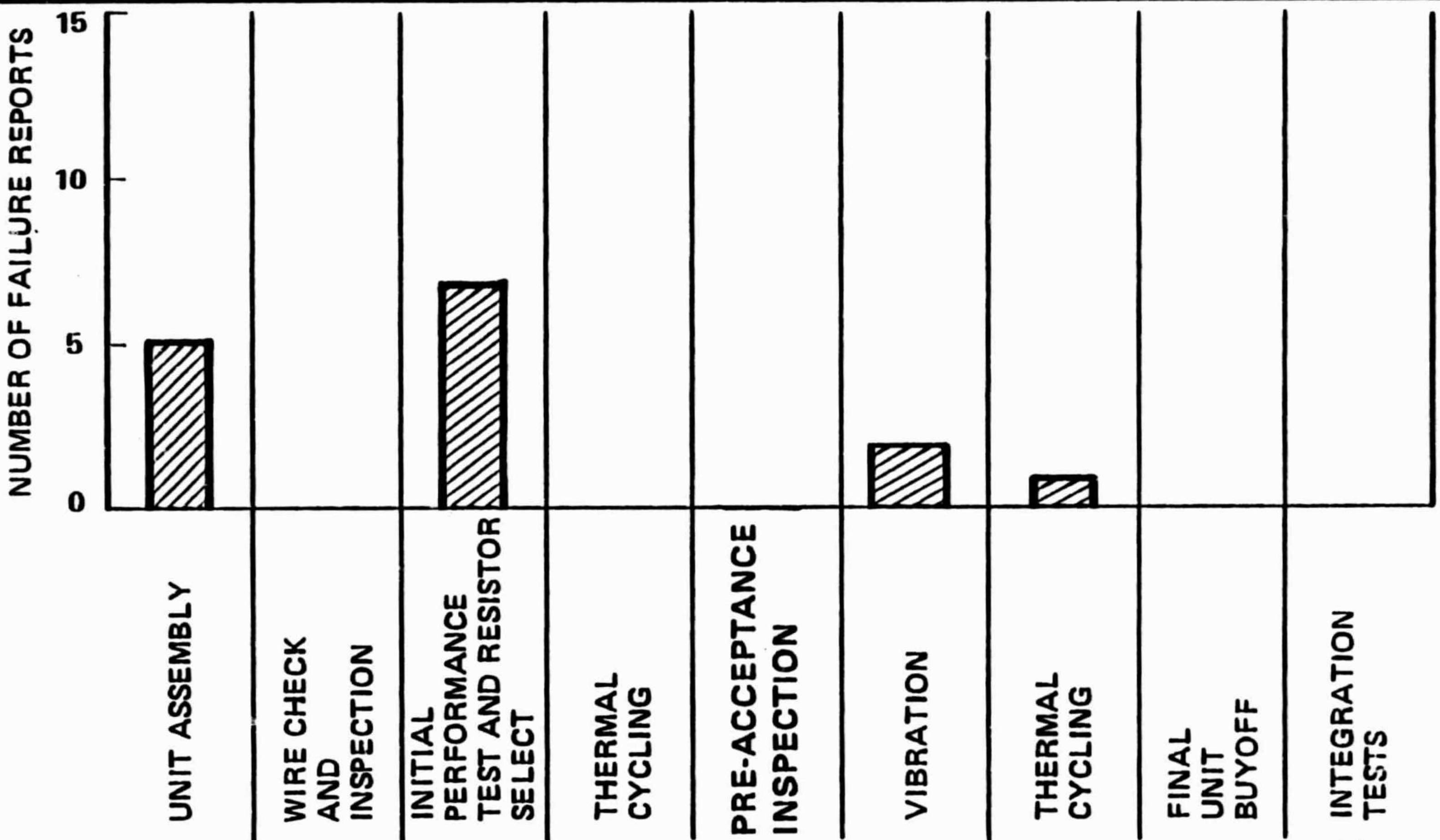

ALL FAILURE REPORTS CLOSED

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FLIGHT MODEL POWER SUPPLY
RDW SUMMARY

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PERFORMANCE

W-101 TURN-ON TRANSIENT FOR THEMATIC MAPPER POWER SUPPLY

ELECTRICAL STRESS

W-092 STRESS LEVEL OF INPUT RFI FILTER (908430-7)

W-093 STRESS LEVEL OF OUTPUT RFI FILTER (909431-2)

MECHANICAL

D-030 USE REA RELEASED TOP ASSEMBLY DRAWING TO ASSEMBLE P/F

D-069 ALTERNATE WIRING ON POWER SUPPLY SUBASSEMBLIES

D-068 ACCEPTABILITY OF SPLICED WIRES REMOVED FROM SHIELD ASSEMBLY

W-074 ALTERNATE ASSEMBLY TECHNIQUES AS DEFINED BY NHB5300.4-3A

W-078 ADDITION OF CUTS AND JUMPERS TO PRINTED WIRING BOARDS

W-079 SPLICING WIRES ON OUTPUT HARNESS

D-102 ADDITION OF WIRES TO SPLICE IN OUTPUT HARNESS

W-104 PWB MATERIAL USED IN THEMATIC MAPPER POWER SUPPLY (SN-4)

D-123 CANCELLED

D-124 LIFTED PADS IN THEMATIC MAPPER POWER SUPPLY (SN-4)

POWER SUPPLY
UNIT SUMMARY

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- FLIGHT POWER SUPPLY MEETS ALL REQUIREMENTS EXCEPT IN-RUSH CURRENT.

- SYNCHRONIZATION SIGNAL DISCONNECTED DURING INTEGRATION TESTS.

- POWER SUPPLY DESIGN AND OPERATION VALIDATED BY UNIT TESTS, INTEGRATION TESTS, AND PROTOFLIGHT INSTRUMENT PERFORMANCE ON LANDSAT D.

THEMATIC MAPPER POWER SUPPLY OUTPUT CHARACTERISTICS

TABLE I

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OUTPUT	SUPPLY VOLTAGE MAX	SUPPLY VOLTAGE MIN	LOAD I MAX	LOAD TEST
CDVU LOGIC	8.80	7.20	800 mA	560 mA
RADIOMETER LOGIC	9.35	7.65	300 mA	300 mA
VIDEO, BAND 1	+ 23.0	18.0	170 mA	170 mA
	– 23.0	18.0	170 mA	170 mA
VIDEO, BAND 2	+ 23.0	18.0	170 mA	170 mA
	– 23.0	18.0	170 mA	170 mA
VIDEO, BAND 3	+ 23.0	18.0	170 mA	170 mA
	– 23.0	18.0	170 mA	170 mA
VIDEO, BAND 4	+ 23.0	18.0	170 mA	170 mA
	– 23.0	18.0	170 mA	170 mA
VIDEO, BAND 5 & 7	+ 23.0	18.0	170 mA	170 mA
	– 23.0	18.0	170 mA	170 mA
VIDEO, BAND 6	+ 23.0	18.0	90 mA	90 mA
	– 23.0	18.0	90 mA	90 mA
SMA HEATER CONTROL	+ 23.32	19.08	110 mA	90 mA
	– 23.32	19.08	8 mA	8 mA
ANALOG FUNCTIONS	+ 23.32	19.08	2.1 A	1.5 A
	– 23.32	19.08	650 mA	650 mA
ELECTROMECHANICAL	36.74	30.06	600 mA	500 mA
OUTGAS HEATERS	88.0	72.0	730 mA	113 Ω LOAD
INCHWORM OR MUX OR PARASITIC HEATER	30.90	29.10 ← FDBK	4.2 A	4.1 A
SCAN MIRROR ASSEMBLY	+ 30.50	28.00 CONTROL VOLT	120 mA	120 mA
	– 30.50	28.00	120 mA	120 mA
	7.90	6.30	2.6 A	5.2A/2.6A
				≈ 270 WATTS

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POWER SUPPLY SPECIFICATION IMPEDANCE BETWEEN RETURNS

TABLE II

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RESISTANCE SHOWN IN OHMS

	(1) PRIMARY S/C POWER RETURN	(2) REDUND. S/C POWER RETURN	(3) SMA POWER RETURN	(4) 80V POWER RE RETURN	(5) SMA HEATER CONTROLLER TRE RETURN	(6) SYNC RETURN	(7) TELEMETRY RETURN	(8) VIDEO BANDS 1-7 POWER RETURN	(9) MULTI-PLEXER TR RETURN
REDUNDANT S/C POWER RETURN	< 1.0	0							
SMA POWER RETURN	1M	1M	0						
80V POWER RETURN	1M	1M	1K	0					
SMA HEATER (CONTROLLER RETURN	1M	1M	50K	50K	0				
SYNC RETURN	5M	5M	5M	5M	5M	0			
TELEMETRY RETURN	1M	1M	750Ω	450Ω	50K	1M	0		
VIDEO BANDS 1-7 POWER RETURN	1M	1M	50K	50K	150K	1M	50K	150K	
MULTIPLEXER RETURN	< 1.0	< 1.0	1M	1M	1M	5M	1M	1M	0

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THEMATIC MAPPER SCAN MIRROR ASSEMBLY

FLIGHT MODEL PRESHIPMENT REVIEW

SEPTEMBER 1982

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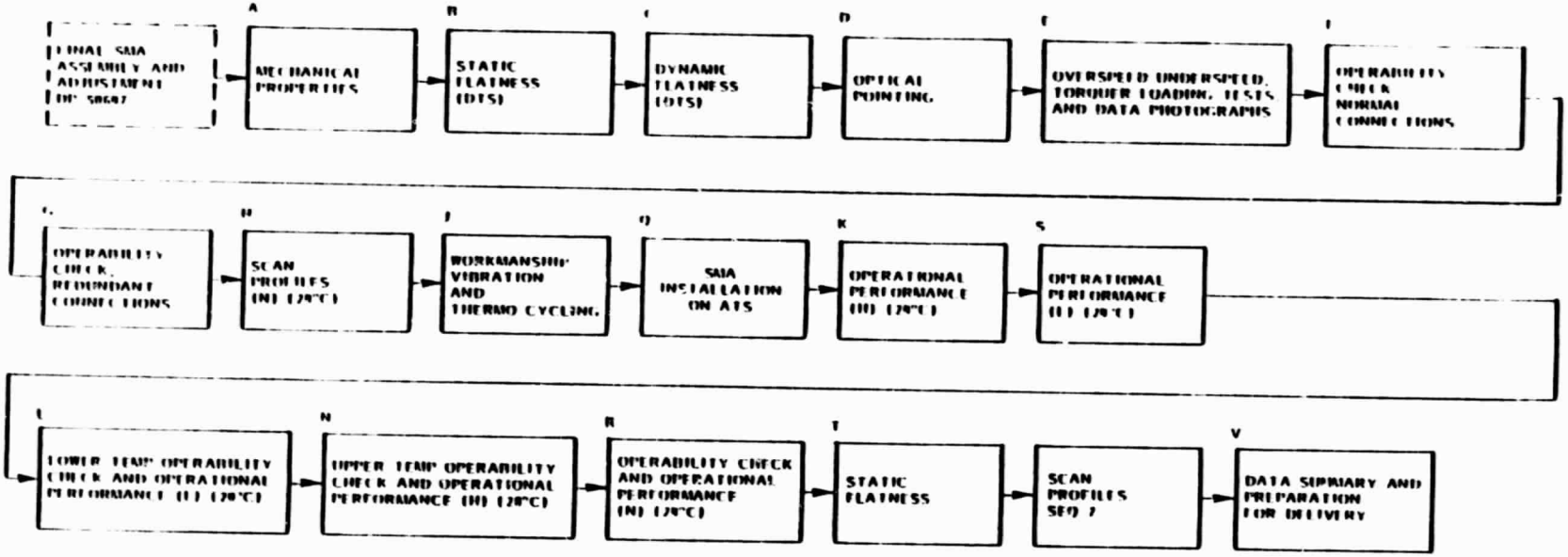
FLIGHT MODEL
SMA TEST FLOW



(a) OVERALL (R N L) INPUT VOLTAGES HIGH, NOMINAL, LOW DTS DEVELOPMENT TEST STATION

FLIGHT MODEL
SMA REQUIREMENTS AND PERFORMANCE
(SAM MODE)

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PARAMETER	SPECIFICATION	TEST DATA 20 TO 28°C	SPEC P / F
OPERATIONAL			
SCAN PERIOD, μ sec	142,526 TO 142,806 (1) 142,510 TO 143,340 (2)	142,665 TO 142,682	P P
ACTIVE SCAN AMPLITUDE, DEG	7.695 ± 0.067	7.697	P
ACTIVE SCAN TIME μ sec	60,743 ± 0.3 (MEAN) < 2.9 (1σ)	60742.9 (MEAN) < 1.0 (1σ)	P P
TURNAROUND TIME, μ sec	10,522 TO 10,658 (1) 10,520 TO 10,920 (2)	10,515 TO 10,670	F (3) F (3)

(1) MANUFACTURING REQUIREMENT (ALLOWS FOR WEAR)
(2) MISSION LIFE REQUIREMENT
(3) ACCEPTABLE AT SYSTEM LEVEL. BUMPERS ADJUSTED FOR MAXIMUM TORQUE PULSE MARGIN.

FLIGHT MODEL
SMA REQUIREMENT AND PERFORMANCE
(SAM MODE)

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PARAMETER	SPECIFICATION	TEST DATA 20 TO 28°C	SPEC P/F
GEOMETRIC ACCURACY			
• ALONG-SCAN PROFILE (LINEARITY), μRAD	≤ ± 17.5	10.1 MAX	P
• ALONG-SCAN PROFILE REPEATABILITY, μRAD	≤ ± 1.75 (1σ)	1.71 (1σ) MAX	P
• CROSS-SCAN PROFILE, μRAD	≤ ± 20.0	1.6 MAX	P
• CROSS-SCAN REPEATABILITY, μRAD	≤ 1.5 (1σ)	1.39 MAX	P
• FORWARD-TO-REVERSE CROSS-SCAN PROFILE (OVERLAP/UNDERLAP, μRAD)	≤ 2.1	1.23 MAX	P
• SCAN RATE, % DEVIATION FROM NOMINAL AVG OVER 1600 μRAD	± 0.094	0.051 MAX	P

FLIGHT MODEL SCAN MIRROR REQUIREMENTS AND PERFORMANCE

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PARAMETER	SPECIFICATION	TEST DATA	SPEC P/F
OPTICAL			
REFLECTIVITY	94% BAND 1 AND 6, 96% BANDS 2 TO 5 AND 7	> 94%,. > 96%	P P
STATIC FLATNESS MAJOR AXIS MINOR AXIS	SLOPE ERROR μRAD RMS	 0.8 0.9	 P P
DYNAMIC FLATNESS	4.5 μRAD RMS	NO CHANGE DETECTED	P
SCATTERING	1% TIS	0.5% TIS	P
CLEAR APERTURE, INCHES	16,280 x 21,080 ELLIPSE (MIN)	16, 280 x 21, 080	P

SCAN MIRROR DATA COMPARISON BY MODEL

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SCAN MIRROR	RMS SLOPE (1) (μRAD)		MTF DEGRADATION (2) (%)	
	MINOR AXIS	MAJOR AXIS	MINOR AXIS	MAJOR AXIS
FLIGHT - 1	0.9	0.8	~1	~1
PROTOFLIGHT	3.6	2.4	5	0.2
LIFE TEST	4.3	3.4	8.8	11.0
ENGINEERING	>5.0	>5.0	>5	>5

(1) SPECIFICATION MODIFIED TO REFLECT THE RMS SCOPE ERROR.

(2) MTF BASED ON GEOMETRIC ANALYSIS OF SCOPE ERRORS.

SCAN MIRROR OPTO-MECHANICAL CHARACTERISTICS BY MODEL

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MODEL	ENGINEERING	LIFE TEST	PROTOFLIGHT	FLIGHT 1
SCAN MIRROR S/N	001	002	004	005
CONSTRUCTION	BRAZED EGG CRATE	MACHINED EGG CRATE	MACHINED EGG CRATE	MACHINED EGG CRATE
MANUFACTURER	ELECTROFUSION, INC.	ELECTROFUSION, INC.	SPEEDRING, INC.	SPEEDRING, INC.
MOMENT OF INERTIA IN LB SEC^2	0.325	0.412	0.375	0.324
WEIGHT SMA, KG	24.49	24.9	23.82	24.89
SIZE (MAJOR X MINOR, IN.)	21.01 x 16.3	21.1 x 16.3	21.1 x 16.3	21.1 x 16.3
REFLECTANCE, % BANDS 1,6: BANDS 2,3,4,5,7:	 94 96	 94 96	 94 96	 94 96
SCATTER, %	0.8	0.17	0.2	0.5
STATIC FLATNESS (1) MAJOR AXIS MINOR AXIS	95% - 25 μ IN./ 100% - 100 μ IN.	3.4 μRAD RMS 4.8 μRAD RMS	2.4 μRAD RMS 3.6 μRAD RMS	0.8 μRAD RMS 0.9 μRAD RMS
DYNAMIC FLATNESS	NO CHANGE FROM STATIC DETECTED	NO CHANGE FROM STATIC DETECTED	NO CHANGE FROM STATIC DETECTED	NO CHANGE FROM STATIC DETECTED
MTF DEGRADATIONS (2)	5%	8.8% MINOR AXIS 11.0% MAJOR AXIS	5% MINOR AXIS 0.2% MAJOR AXIS	1% MINOR AXIS 1% MAJOR AXIS
COATING	PROTECTED SILVER SURFACE ON BARE BERYLLIUM	PROTECTED SILVER SURFACE ON NICKEL PLATED BERYLLIUM SLIGHT DEGRADATION	PROTECTED SILVER SURFACE ON NICKEL PLATED BERYLLIUM	PROTECTED SILVER SURFACE ON NICKEL PLATED BERYLLIUM

(1) SPECIFICATION MODIFIED TO REFLECT RMS SLOPE ERROR
(2) MTF BASED ON GEOMETRIC ANALYSIS OF SLOPE ERRORS

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SUMMARY OF SMA UNIQUE CHARACTERISTICS BY MODEL

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FEATURE	ENGINEERING MODEL 001	LIFE TEST MODEL 002	PROTOFLIGHT MODEL 003	FLIGHT 1 MODEL 004	COMMENTS
ELECTRONICS					
ACTIVE SCAN CURRENT R2, R5	OPTIMUM (390Ω)	OPTIMUM (292Ω)	NONOPTIMUM (292 Ω)	NONOPTIMUM (292 Ω)	PROFILES NOT IDEAL
SAM C22, C23, C24	MISSING ON SAM (1)				POSSIBLE EMI SENSITIVITY, SME (1)
DC SAM SIGNAL	450 mV (1), 350 mV (2)	1200 mV	2600 mV	3000 mV	FILTER AND ALIGN DIFFERENCES
SME LENS	(NON FLIGHT)	DOWNGRADED	NONE	NONE	LTM RELIABILITY; REWORK FOR FLIGHT USE
CABLES	TERMINATIONS OLD DESIGN	SAM AND BUMPER SHIELDS DEFECTIVE			REPLACE FOR FLIGHT USE
AUX TEMP SENSORS	RT 3, 4, 5 INTACT				SME/SAM INTERNAL TEMPERATURE MONITORING POSSIBLE (IRS 236 1490)
CONFORMAL COATING	NO	YES	YES	YES	SMA ENVIRONMENTALLY PROTECTED
MECHANICAL					
HANDLES	NO	YES	YES	YES	PROVISION FOR SAFETY
SAM PRIMARY MIRROR STIFFENERS	NO	YES	YES	YES	SAM OFFSETS VARY ON EM (MIDSCAN CORRECTION NOT IDEAL)
TURNAROUND TIME VARIATIONS	YES	MEETS SPEC	MEETS SPEC	EXCEEDS SPEC	SLIGHTLY OUT OF SPEC ON FT, EM VARIABLE
FRAME FLATNESS		3 MILS	5 MILS	4 MILS	SHIMS REQUIRED
ADDED INERTIA	YES	NO	NO	NO	MASSES NEAR STRIKER PLATES (TO INCREASE INERTIA)
FLEX PIVOT BONDED	YES	NO	NO	NO	NONE
SAM ELEC BASE SLOTTED	NO	YES	YES	YES	NONE
SME PKG ENLARGED BY SPACERS	NO	YES	YES	YES	NONE

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SUMMARY

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- F1 SMA MET OR EXCEEDED ALL* SPECIFICATIONS
- ACCEPTABLE PERFORMANCE EXPECTED OVER MISSION LIFE
- LIFE TEST DATA SUPPORTS THIS EXPECTATION
    - ONLY FAILURE INCURRED (TURNAROUND TIME) AT SPEC EDGE - WILL WEAR IN SPEC DIRECTION

ELECTRONIC MODULE

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ELECTRONIC MODULE PRESHIPMENT REVIEW TOPICS

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- FUNCTIONAL LISTING
- MODULE INTERFACES
- MODULE TEST REQUIREMENTS AND PERFORMANCE
- PHYSICAL DESCRIPTION
- DESIGN CHANGE SUMMARY
- FAILURE REPORT SUMMARY
- DEVIATION / WAIVER SUMMARY
- STATUS SUMMARY

ELECTRONIC MODULE FUNCTIONAL LISTING

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COMMAND DECODE VERIFICATION UNIT (CDVU)

- 6 PWBs - DIGITAL COMMAND / TELEMETRY INTERFACE WITH SPACECRAFT REMOTE INTERFACE UNIT (RIU)

MECHANISM CONTROLLERS

- SCAN LINE CORRECTOR (SLC) - 2 INDEPENDENT CONTROLLERS
- ON BOARD CALIBRATOR (OBC) MAIN SHUTTER DRIVER
  - MAIN SHUTTER ASIDE FUSELINK DRIVER
- BACKUP SHUTTER DRIVER
- COOLER DOOR MOTOR DRIVER
  - COOLER DOOR OPEN FUSELINK DRIVER
- TELESCOPE INCHWORM POWER SUPPLY SEQUENCER
  - LINEAR VARIABLE DIFFERENTIAL TRANSFORMERS (LVDT) POSITION INDICATOR (POWER AND ANALOG TELEMETRY SCALING)

ELECTRONIC MODULE FUNCTIONAL LISTING

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TEMPERATURE CONTROL

- ELECTRONIC MODULE HEATER
- BLACKBODY HEATER CONTROLLER
- COOLER COLD FOCAL PLANE ARRAY (CFPA) HEATER CONTROLLER
- COOLER COLD STAGE, COLD STAGE OUTGAS HEATER CONTROLLER
- COOLER DOOR HEATER
- INTERMEDIATE STAGE OUTGAS HEATER CONTROLLER
- SAFEHOLD HEATERS
- SCAN MIRROR ASSEMBLY (SMA) ± Z AXIS HEATERS
- BAFFLE HEATER

CALIBRATION OPTICAL SOURCE

- 3 CALIBRATION LAMP CONTROLLERS AND SEQUENCER TO PROVIDE EIGHT DEFINED OPTICAL FLUX INTENSITY LEVELS

HOUSING AND INTEGRATION WITH VIDEO POST AMPLIFIERS PRESENTED ELSEWHERE

HOUSING AND INTEGRATION WITH MULTIPLEXER TIMING AND RESTORED VIDEO SIGNALS PRESENTED ELSEWHERE

HOUSING AND INTEGRATION WITH POWER SUPPLY PRESENTED ELSEWHERE

ELECTRONIC MODULE INTERFACES

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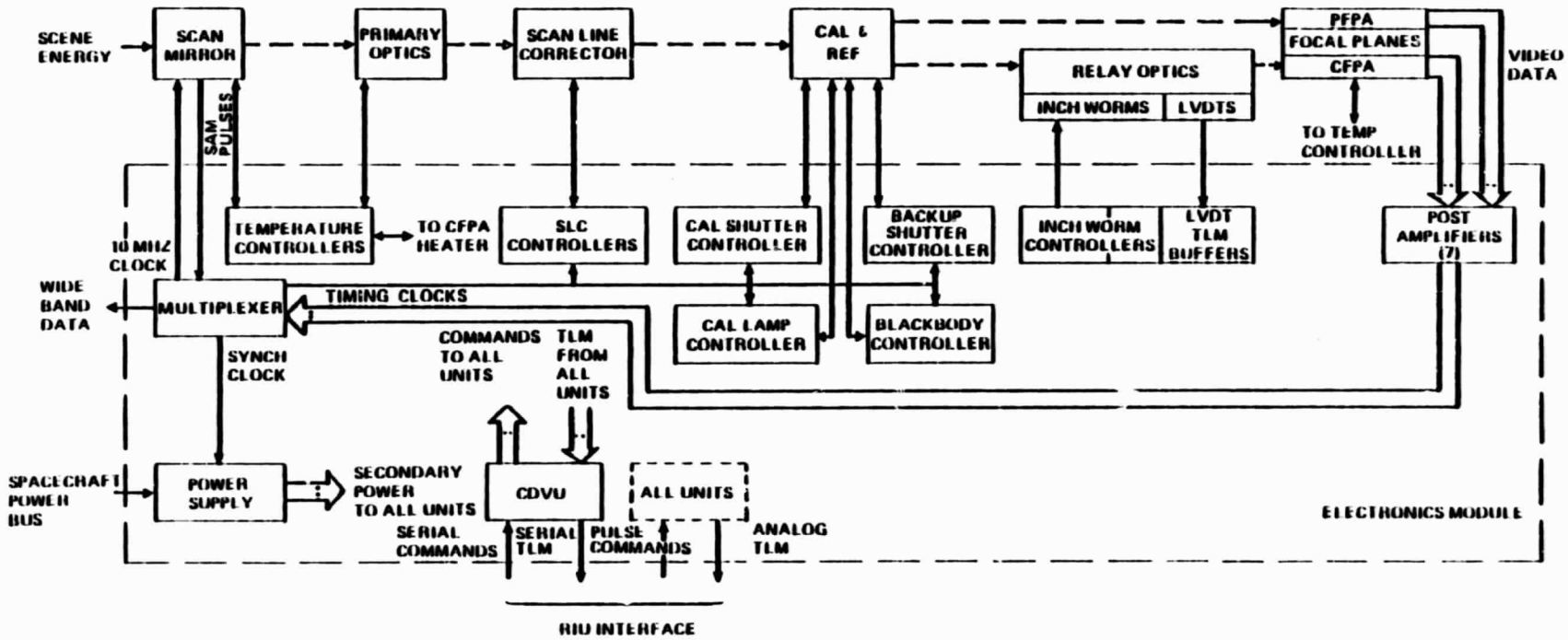

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UNIT LEVEL (PRE-INTEGRATION) FLIGHT ELECTRONIC MODULE ENVIRONMENTAL TEST REQUIREMENTS

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- TEMPERATURE (DS32015-003)

  DESIGN / TEST 0°C TO +50°C (CDVU START AT -25°C)
  THERMAL CYCLE -30°C TO +60°C (12 CYCLES)

- RADIATION (HS 236-0834)

  EXPECTED 2 YR DOSE 6-22 X 10^3 RAD (SI)

- QUAL VIBRATION (HS 236-6520) PROTOFLIGHT ONLY
  (WORST CASE AXIS)

	FREQUENCY, (HZ)	ACCELERATION
SINE SWEEP (PERPENDICULAR TO THRUST)	5 TO 12	0.8 IN (DBL. AMPL.)
	12 TO 40	6 G (PK)
	40 TO 50	7.5 G (PK)
	50 TO 74	14 G (PK)
	74 TO 88	20 G (PK)
	90 TO 100	8 G (PK)
RANDOM (ALL AXES)	20-2000	10.1 G (RMS)

FLIGHT ELECTRONIC MODULE TEST PROGRAM

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PWB LEVEL TEST SEQUENCE	FUNCTIONAL TEST - AMBIENT
	DETERMINE SELECTS (WITH ACTUAL MECHANISM OR HEATER LOADS AS APPLICABLE) - AMBIENT
	FUNCTIONAL TEST TO VERIFY SELECTS - AMBIENT
	THERMAL CYCLE - 12 CYCLES -30°C TO +60°C
	FUNCTIONAL TEST - AMBIENT
	HIGH TEMPERATURE TEST - +50°C
	LOW TEMPERATURE TEST - 0°C
	HIGH BUS TEST - AMBIENT
	LOW BUS TEST - AMBIENT
	BOND COMPONENTS, CONFORMALLY COAT PWB
	FUNCTIONAL TEST - AMBIENT
MODULE LEVEL	CDVU PWB INTEGRATION
	MECHANISM / HEATER DRIVER PWB INTEGRATION
	POST-AMPLIFIER PWB INTEGRATION
	MUX INTEGRATION
	POWER SUPPLY INTEGRATION
SYSTEM LEVEL	IA07 TEST
	SUBSEQUENT PERFORMANCE TESTING

FLIGHT ELECTRONIC MODULE FUNCTIONAL CHECKS

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FUNCTION	PRINTED WIRE BOARD (PWB)-LOAD INTERFACES	MODULE INTEGRATION SIMULATED LOADS/ SIGNALS	SCANNER ELECTRICAL SYSTEM INTEGRATION-IA07
CDVU BOARDS	DIGITAL INTERFACE CHECK WITH RIU SIMULATOR ALL BOARDS CHECKED FOR LIFE RELIABILITY	FUNCTIONAL (SPEC) COMPLIANCE CHECK	FUNCTIONAL COMPLIANCE CHECK
SCAN LINE CORRECTOR CONTROLLERS	RESISTORS SELECTED-SPEC LINEARITY COMPLIANCE	COMPLIANCE CHECK	COMPLIANCE CHECK WITH WIDEBAND MUX DATA
ON BOARD CALIBRATOR (MAIN SHUTTER) DRIVER	RESISTORS SELECTED-AMPLITUDE/PHASE LOCK STABILITY	COMPLIANCE CHECK	COMPLIANCE CHECK WITH MUX DATA AND SYSTEM TIMING TESTS
BACKUP SHUTTER DRIVER	RESISTORS SELECTED-AMPLITUDE/PHASE LOCK STABILITY	COMPLIANCE CHECK	COMPLIANCE CHECK SYSTEM TIMING TESTS
COOLER DOOR MOTOR DRIVE CONTROL	TIMING CHECK;MECHANISM POSITION ADJUSTED	COMPLIANCE CHECK	COMPLIANCE CHECK
INCHWORM PWR SUPPLY SEQUENCER	RESISTORS SELECTED FOR SPEC TIMING/VOLTAGE AND CHECK WITH INCHWORM; VACUUM COMPATIBILITY TEST	COMPLIANCE CHECK	COMPLIANCE CHECK BY TELESCOPE FOCUSING

FLIGHT ELECTRONIC MODULE FUNCTIONAL CHECKS

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FUNCTION	PRINTED WIRE BOARD (PWB)-LOAD INTERFACE	MODULE INTEGRATION SIMULATED LOADS/ SIGNALS	SCANNER ELECTRICAL SYSTEM INTEGRATION-IA07
BLACKBODY HEATER	RESISTORS SELECTED-TEMP SETPOINT	COMPLIANCE CHECK	COMPLIANCE CHECK WITH ACTUAL BLACKBODY
CFPA HEATER	RESISTORS SELECTED-RADIATIVE COOLER THERMAL VACUUM TEST	COMPLIANCE CHECK	COMPLIANCE CHECK RADIATIVE COOLER
COLD STAGE, COLD STAGE OUTGAS HEATER	RESISTORS SELECTED-RADIATIVE COOLER INTERFACE	COMPLIANCE CHECK	COMPLIANCE CHECK RADIATIVE COOLER
INTERMEDIATE STAGE OUTGAS HEATER	RESISTORS SELECTED-RADIATIVE COOLER INTERFACE	COMPLIANCE CHECK	COMPLIANCE CHECK WITH RADIATIVE COOLER
SMA 1Z HEATER	COMPLIANCE WITH TEMP SETPOINTS AS SPECIFIED	COMPLIANCE CHECK	COMPLIANCE CHECK WITH SMA
CALIBRATION OPTICAL SOURCE	RESISTORS SELECTED-ACTUAL CAL LAMPS	COMPLIANCE CHECK	COMPLIANCE CHECK
CALIBRATION LAMP SEQUENCING	SPECIFIED TIMING CHECKED	COMPLIANCE CHECK	COMPLIANCE CHECK

THEMATIC MAPPER
RADIOMETER ASSEMBLY

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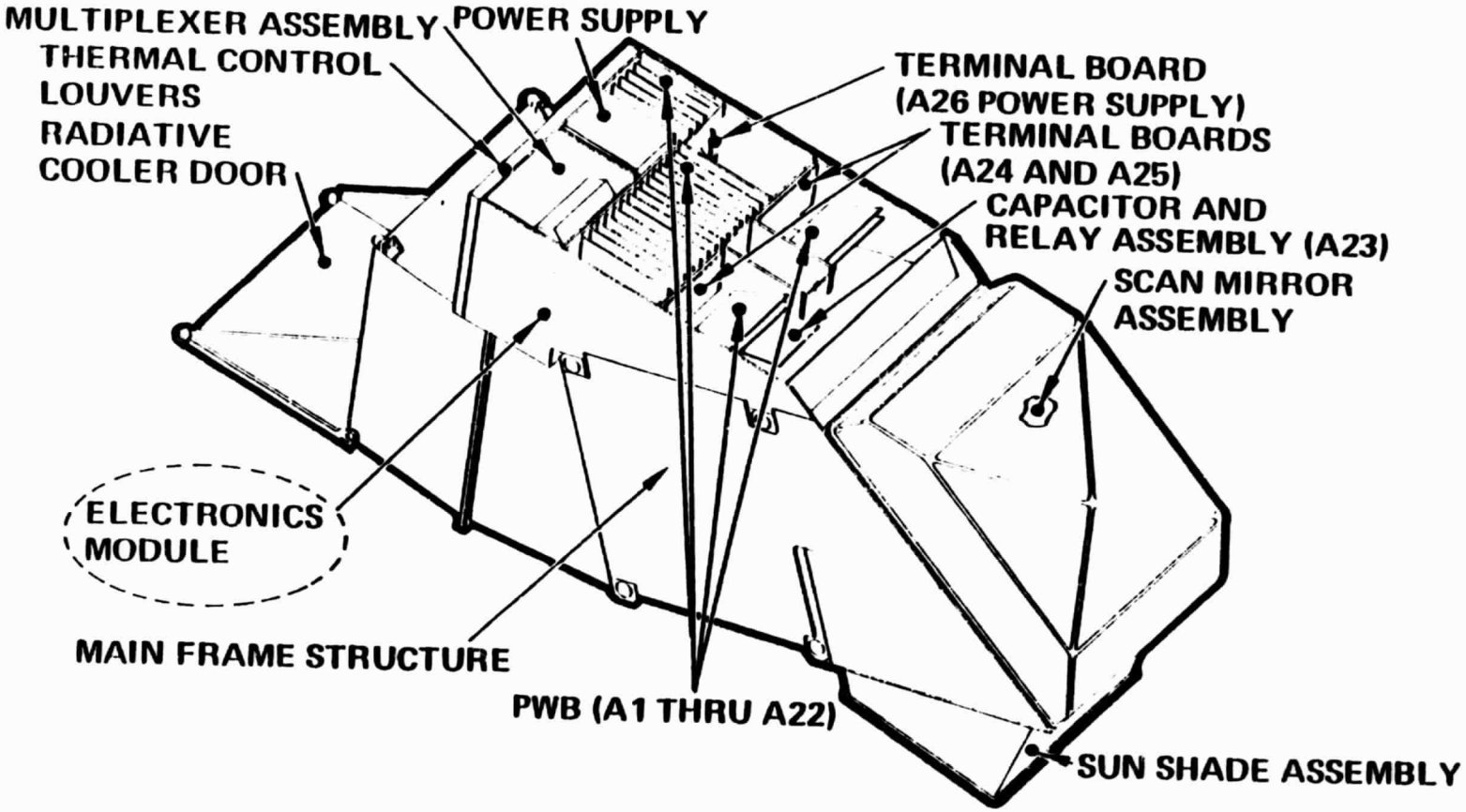

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DESIGN CHANGES IN FLIGHT ELECTRONIC MODULE NOT MADE IN PROTOFLIGHT

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FUNCTIONAL PROBLEM	SOLUTION
POWER SUPPLY #2 SELF SHUTDOWN (F3868)	OPENED SYNC LINES FROM MUX (BOTH POWER SUPPLIES)
COHERENT NOISE IN BAND 1 (W-167, FR 5779)	INSTALLED 16 RESISTORS IN SIGNAL RETURN LINES OF B1 POSTAMP PWB
BAND 6 FAILURE TO TURN ON OCCASIONALLY (F2385)	CORRECTED 50912 PWB TO MAKE ±15V REGULATOR PASS TRANSISTORS FUNCTIONAL
BACKUP SHUTTER HAD EXCESSIVE PHASE JITTER (EO 4031A)	ADDED CAPACITOR FILTERS TO 51398 PWB
BACKUP SHUTTER SYMMETRY DISTURBED BY MOTOR (TORQUER) INSTALLATION (58128)	INSTALLED 2 PARALLEL RESISTORS ON 51398 PWB. VALUE OUTSIDE PREVIOUS SELECT RANGE.
BACKUP SHUTTER SOMETIMES FAILED TO LOCK UP AFTER POWER SUPPLY SYNC LINES WERE OPENED (EO's 4432A and 4433A)	ADDED CAPACITORS ACROSS PHOTOTRANSISTOR LEADS TO FILTER NOISE SPIKES. CHANGED RESISTOR TO RE-ESTABLISH CORRECT TIMING BETWEEN DC RESTORE PULSE AND SHUTTER SHADOW
OSCILLATIONS AT 200 kHz (LOW LEVEL) IN BIAS CONTROL LOOPS FOR THE 2 CFPA TEMP SENSE DIODES CAUSED HIGH NOISE READINGS IN COOLER UNIT TEST (EO's 4343A AND 4344A)	ADDED A CAPACITOR TO EACH LOOP TO STOP OSCILLATIONS

FLIGHT ELECTRONIC MODEL SUMMARY OF TYPES OF FAILURE REPORTS

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FAILURE TYPE	NO. OF FAILURE REPORTS
WORKMANSHIP / HANDLING (FAB AND ASSY.)	25
DESIGN (CIRCUIT AND PRODUCT)	8
TEST SPEC ERROR	15
TEST INSTRUMENTATION ERROR	9
COMPONENT FAILURE	4
PLANNING ERROR	1
UNDETERMINED	2
TOTAL	64

FLIGHT ELECTRONIC MODULE DEVIATION/WAIVER SUMMARY BY TYPE

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TYPE	NO. DEVIATIONS
PWB CUTS, JUMPERS AND ALTERNATE COMPONENT MOUNTING	11
ALTERNATE TERMINAL TYPE	1
TOTAL	12

TYPE	NO. WAIVERS
PWB CUTS, JUMPERS AND ALTERNATE COMPONENT MOUNTING	1
SPEC RELIEF	1
TOTAL	2

FLIGHT ELECTRONIC MODULE STATUS SUMMARY

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THE ELECTRONIC MODULE STRUCTURE, HARNESS, CIRCUIT BOARDS AND INTERFACES HAVE BEEN ENVIRONMENTALLY TESTED AND ARE CONSIDERED QUALIFIED FOR FLIGHT.

NO LIENS EXIST ON FLIGHT MODULE. THERE ARE NO KNOWN PROBLEMS IN THE MODULE JEOPARDIZING FLIGHT INTEGRITY.

FOCAL PLANE ASSEMBLIES

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PRIME FOCAL PLANE ASSEMBLY
50795

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BANDS 1 THROUGH 4, VIDEO CHANNELS

PHOTON FLUX FROM TELESCOPE

⬭

50975 PRIME FOCAL PLANE ASSEMBLY

- FOUR 50797 BAND LEVEL ASSEMBLIES
- ONE 50807 LED ASSEMBLY

⬭

51015 PREAMPLIFIER ASSEMBLY

50904-1

⬭

50904-2

50904-3 POST AMPLIFIER

50904-4

⬭

TO MUX

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PRIME FOCAL PLANE ARRAY

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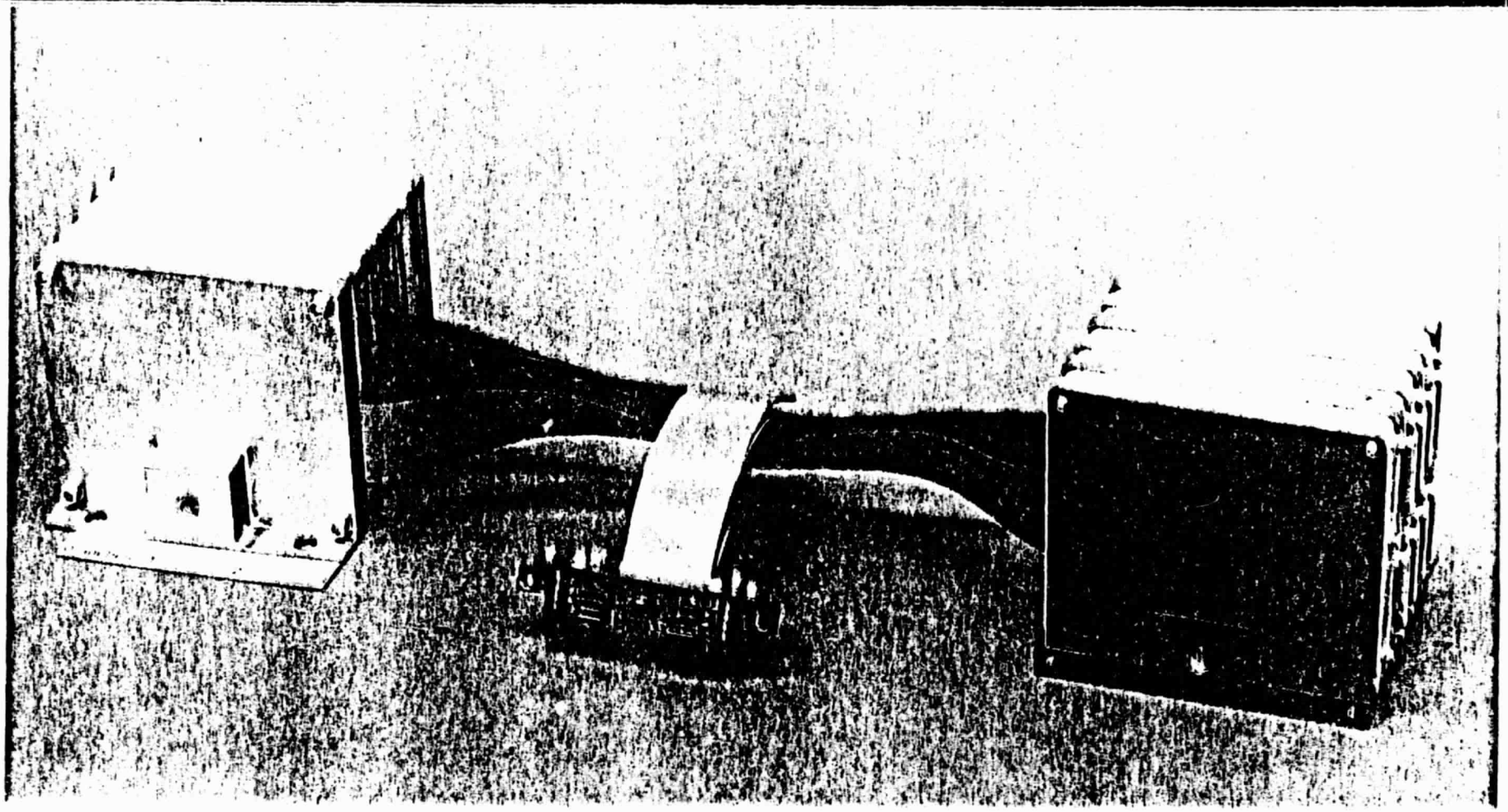

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CLOSEUP OF DETECTORS IN PFPA

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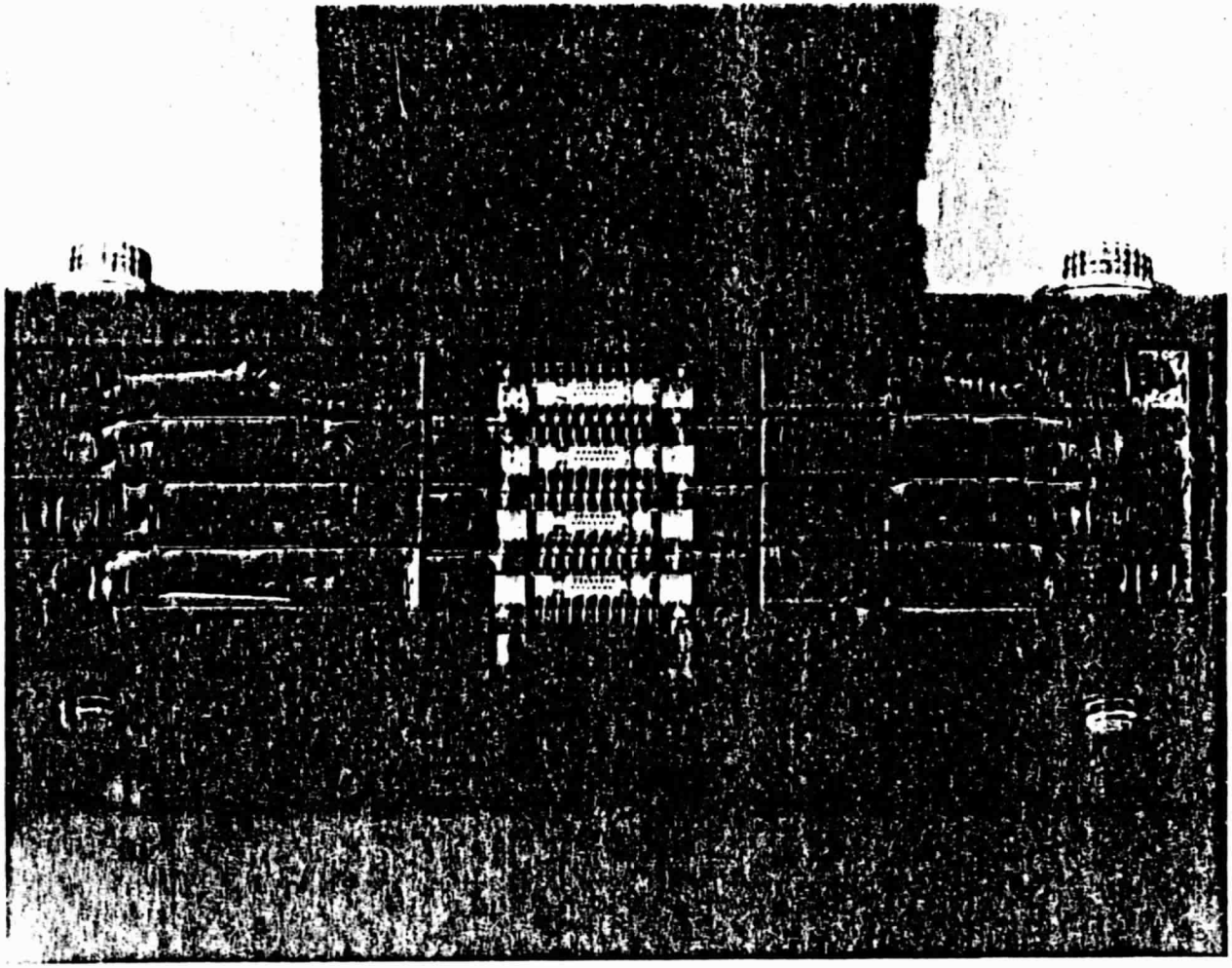

PRIME FOCAL PLANE ASSEMBLY DETAIL

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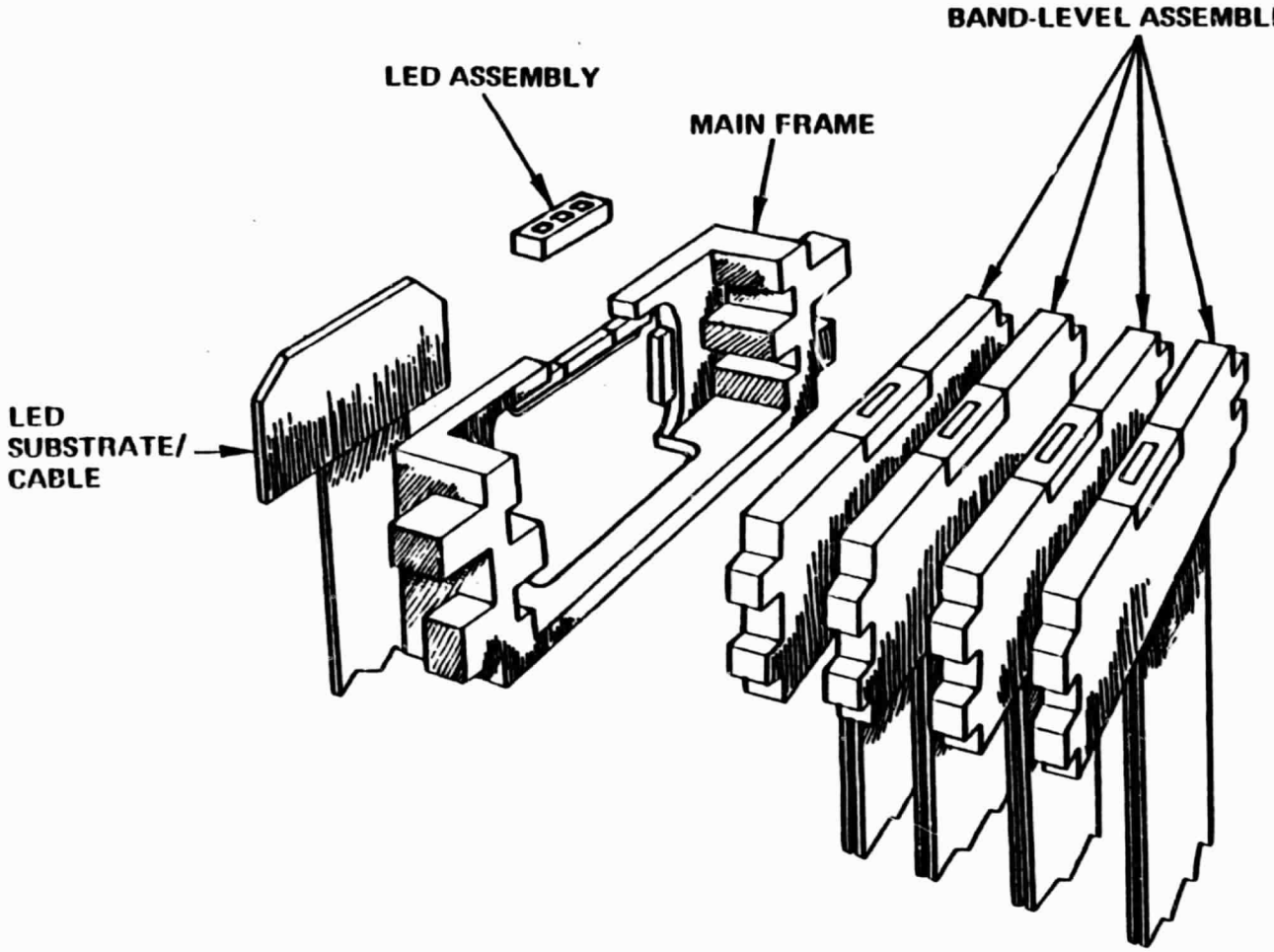

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BAND LEVEL ASSEMBLY

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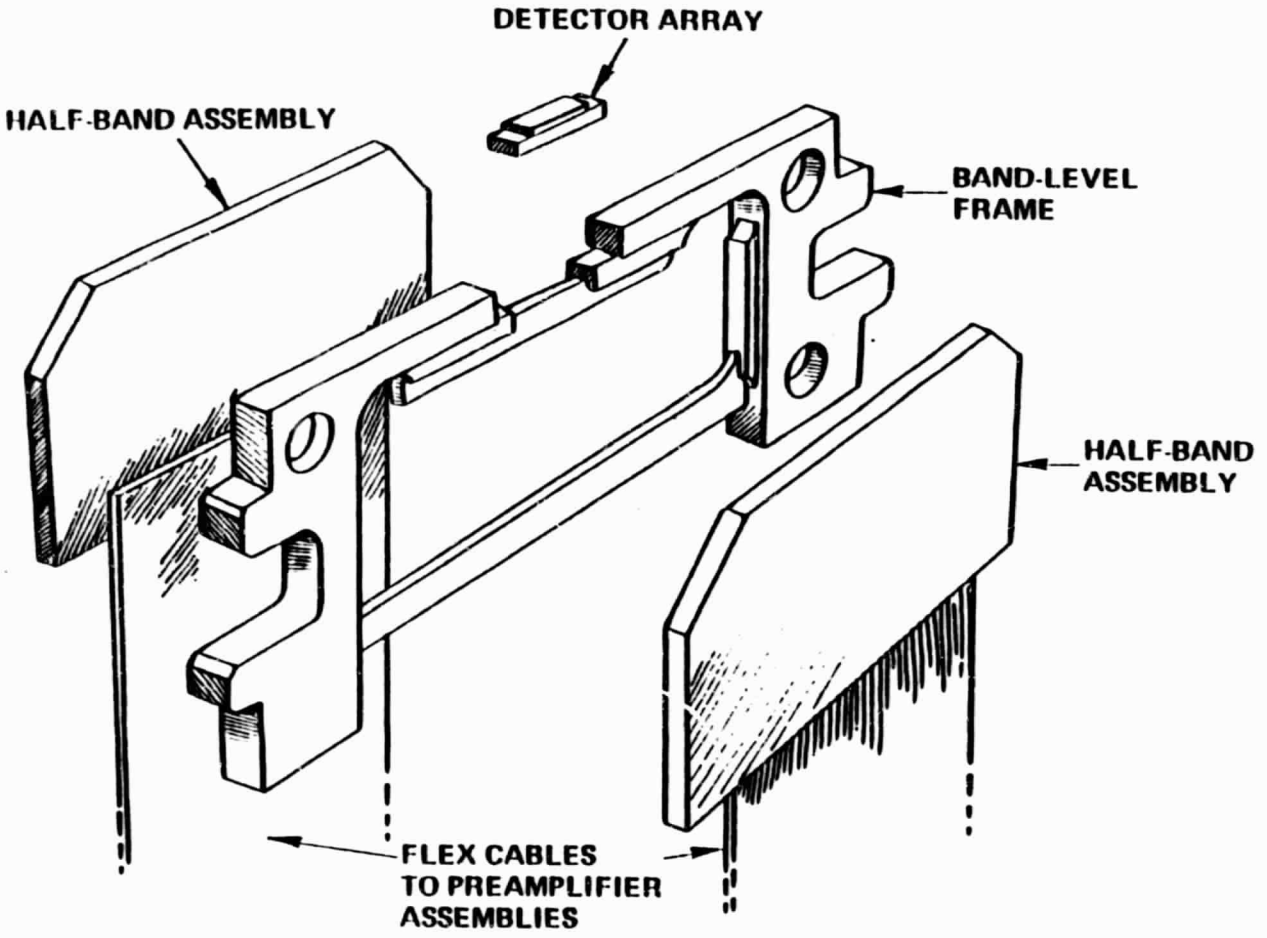
BAND 1-4 ASSEMBLY EXPLODED VIEW



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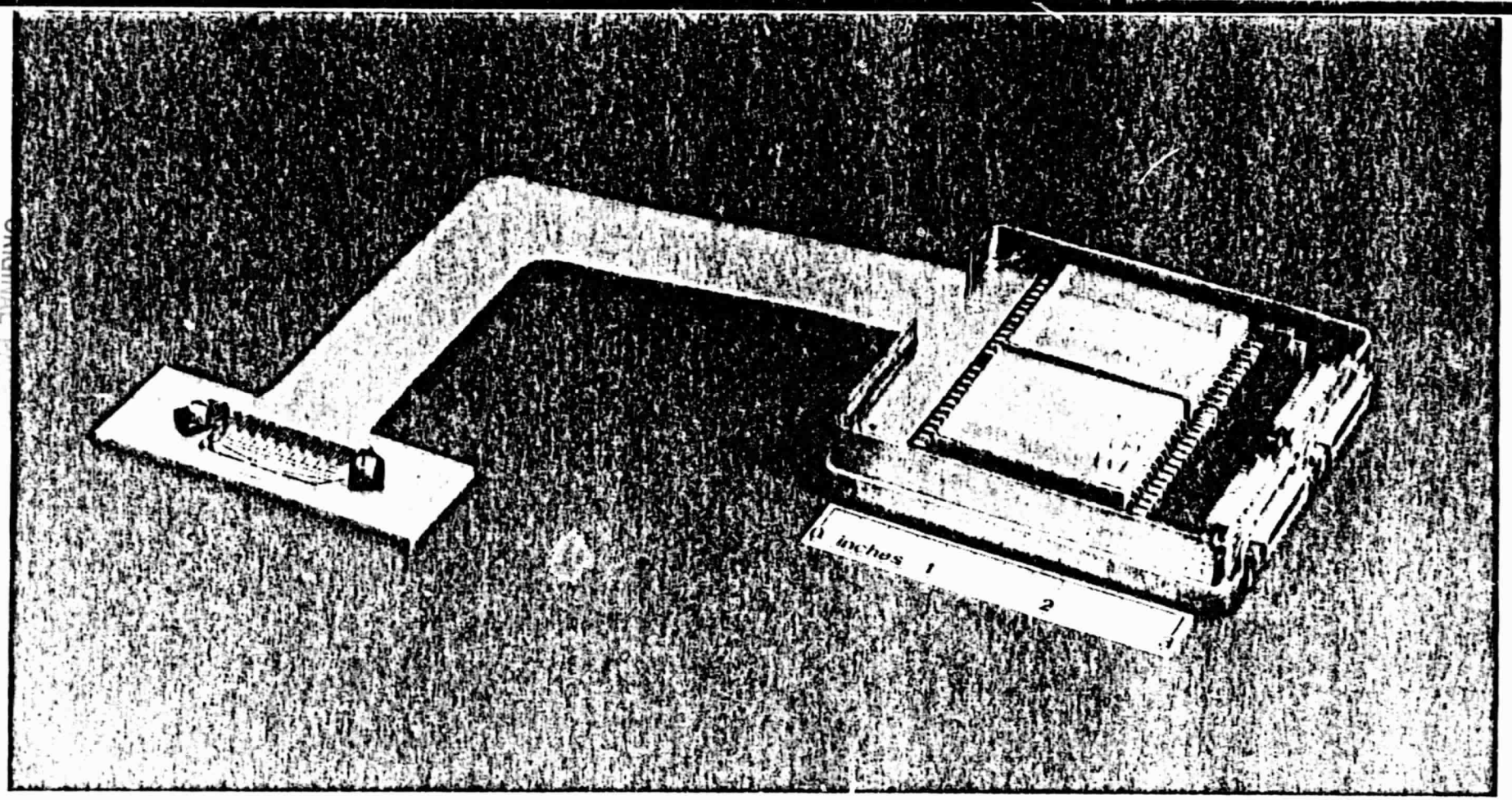
PREAMPLIFIER ASSEMBLY
HALFBAND



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SUBSTRATE ASSEMBLY

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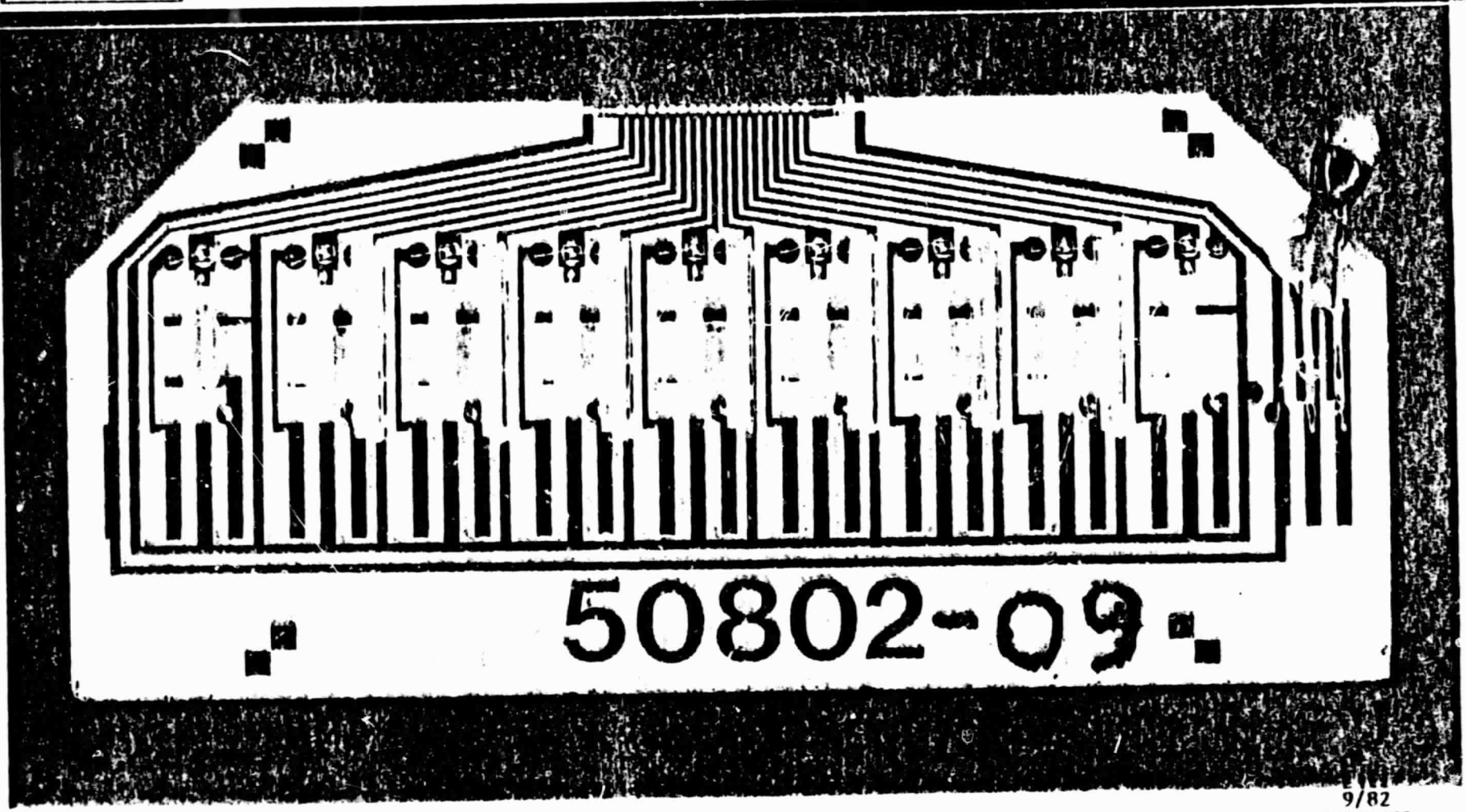

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PRIME FOCAL PLANE ASSEMBLY
50795

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FUNCTION

- TRANSDUCER WHICH CONVERTS INCOMING PHOTON FLUX TO ELECTRICAL SIGNALS THAT MAY BE AMPLIFIED AND PASSED ON TO MUX

CRITICAL PARAMETERS

- BAND TO BAND REGISTRATION MUST BE PRECISE (±150μ IN.)
- LOW INPUT CAPACITANCE (3.0 pF)
- FEEDBACK RESISTOR MUST PRODUCE PROPER FREQUENCY AND TRANSIENT RESPONSE
- PREAMP HIGH GAIN (X1000)
- PREAMP OPEN LOOP - 3 dB FREQUENCY 5 kHz
- SETTLING TIME (TRANSIENT RESPONSE) 1% WITHIN 60μS, 1.5% WITHIN 30μS
- FREQUENCY RESPONSE FLATNESS TO 52 kHz ± 0.5 dB ($\frac{1}{2}$) dB
- WIDEBAND NOISE (2.4 pA)

PRIME FOCAL PLANE ASSEMBLY 50795 (CONT)

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REQUIREMENTS CHANGES SINCE DDR

- PREAMP HYBRID (50860) NOISE RELAXED TO 1.9 nV / Hz AT 50 kHz TO INCREASE YIELD
- PREAMP HYBRID (50860) FREQUENCY RESPONSE REQUIREMENT MODIFIED TO MATCH CHARACTERISTICS OF FOCAL PLANE
- RELAXATION IN SETTLING TIME
- RELAXATION IN WIDEBAND NOISE

DESIGN CHANGES SINCE DDR

- ADDED SHIELD TO 52421 FILTER ASSEMBLIES TO OBSCURE PHOTON SENSITIVE AREAS AROUND BONDING PADS OF DETECTOR
- * DETECTOR (50803) PACKAGING SPECIFICATION ADDED TO REQUIRE PERMANENT GOLD WIREBONDS INSTEAD OF TEMPORARY ALUMINUM WIREBONDS; SEE FR F1723

* DESIGN CHANGES NOT INCORPORATED IN ENGINEERING MODEL

PRIME FOCAL PLANE ASSEMBLY 50795 (CONT)

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** • BAND LEVEL ASSEMBLY 50797 FRAME AND LED ASSEMBLY 50807 BRACKET WERE MADE OF Br INSTEAD OF INVAR TO INCREASE STIFFNESS AND REDUCE STRESS IN 50802 QUARTZ SUBSTRATES

• FABRICATION PROCESS CHANGE TO IMPROVE COMMON CONTACT OF 50803 DETECTORS. (FORWARD CURRENT REQUIREMENT ADDED TO DETECTOR TEST SPECIFICATION TO TEST CONTACT RESISTANCE)

* • BOTTOM OF LED BRACKET CUT AWAY SO THAT BAND LEVEL CABLES MAY EXIT WITHOUT MAKING SHARP BEND

• PREAMP HYBRID (50860)

  • CHANGED R18 AND R19 TO 10K FROM 1K TO IMPROVE NOISE PERFORMANCE

  • CHANGED R17 FROM 20.5K TO 10K TO IMPROVE BIAS STABILITY OVER TEMPERATURE

  • CHANGED C3 FROM 220 pF TO 680 pF TO PROVIDE PROPER CLOSED LOOP COMPENSATION

* DESIGN CHANGES NOT INCORPORATED IN ENGINEERING MODEL

** DESIGN CHANGES NOT INCORPORATED IN P7 MODEL.

PRIME FOCAL PLANE ASSEMBLY 50795 (CONT)

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- REMOVED INPUT COMPENSATION COMPONENTS
- BAND LEVEL ASSEMBLY 50797 CHANGED TO ALLOW USE OF DC 93-500 AND FRAMES MODIFIED TO REDUCE STREE IN
- 50802 QUARTZ SUBSTRATES
    - ADDED SHIELDS TO REDUCE CHANNEL TO CHANNEL CROSSTALK. 0.012 IN. SAWED OFF FEEDBACK RESISTOR OUTPUT END TO ADJUST FEEDBACK CAPACITANCE VALUE TO IDEALIZE FREQUENCY RESPONSE
    - DELETED GUARD RESISTOR FROM BACK OF RESISTOR CHIP. REVISED BONDING PAD CONFIGURATION TO ALLOW CONNECTION OF FEEDBACK CAPACITOR TO IMPROVE FREQUENCY AND TRANSIENT RESPONSE
    - METALIZED BACKSIDE OF 50802 SUBSTRATE TO REDUCE BAND-TO-BAND CROSSTALK
- ALLOWED USE OF CROSSTALK SHIELD POSITION TO FINE TUNE TRANSIENT RESPONSE
- GROUNDED PREAMP CHASSIS THROUGH POWER SUPPLY RETURN TO REDUCE EMI PICKUP. ISOLATED FROM TM CHASSIS
- REMOVED ALIGNMENT CHANNEL

PRIME FOCAL PLANE ASSEMBLY 50795 (CONT)

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ENVIRONMENTAL TESTING

- PROOF OF DESIGN MODEL VIBRATED 6 TIMES PER 16911 AND THERMAL CYCLED BETWEEN -10°C AND 50°C
- FURTHER TESTING TO BE ACCOMPLISHED WHILE MATED TO AFT OPTICS BULKHEAD

STATUS / PROBLEMS

- COMPLETE

PRIME FPA FLOW CHART

SBRC

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50799
SUBSTRATE ASSY
AND TEST

51015
HALFBAND ASSY
AND TEST

10797
BAND LEVEL
ASSY AND TEST

50807
LED ASSY
AND TEST

50795
PRIME FPA
ASSY AND TEST

UNIT LEVEL
VIBRATION

9/82
21170-169

BAND 1 THRU 4 DATA SUMMARY

SBRC

ITEM		1		2		3		4	
	SPEC	$\bar{X}$	RANGE	$\bar{X}$	RANGE	$\bar{X}$	RANGE	$\bar{X}$	RANGE
WIDEBAND NOISE, pA	< 2.4	1.9	1.8 TO 2.0	2.0	1.8 TO 2.2	2.2	2.0 TO 2.9	2.1	2.0 TO 2.3
TIME DELAY, µSEC	TBD ± 0.5	12.0	9.0 TO 16.0	12.0	11.0 TO 13.0	12.0	11.4 TO 12.4	11.5	11.0 TO 12.0
RISE TIME, µSEC	< 20	9.5	9.0 TO 9.8	11.6	11.4 TO 12.0	11.9	11.6 TO 12.4	11.3	10.8 TO 11.8
FALL TIME, µSEC	< 20	15.0	14.4 TO 15.6	12.1	11.8 TO 12.6	11.7	11.4 TO 12.2	11.8	11.4 TO 12.2
FREQUENCY/TRANSIENT RESPONSE									
SETTLING TIME, %	1.5 AFTER 30 µSEC	1.7	0.9 TO 2.6	1.0	0 TO 2.0	1.8	1.0 TO 2.6	1.3	0.2 TO 2.0
	1.0 AFTER 60 µSEC	0.8	0.1 TO 1.3	1.0	0 TO 1.9	0.2	0 TO 1.0	0.4	0 TO 2.0
OVERSHOOT, %	< 10	2.4	-1.5 TO 5.5	3.4	1.0 TO 7.8	4.0	2.0 TO 7.0	4.4	1.5 TO 7.5
FREQUENCY RESPONSE, dB	$-3^{-0}_{+0.5}$ AT 52 kHz	-2.6	-2.2 TO -3.0	-2.9	-2.7 TO -3.1	-2.9	-2.7 TO -3.0	2.8	2.6 TO 2.9
	FLAT ±0.5		*		PASSED		PASSED		PASSED
CROSSTALK AT 50 kHz, dB									
4 NEAREST NEIGHBORS	< 1% (-40 dB)	--	-41 TO -74	--	-41 TO -64	--	-41 TO -66	--	-41 TO -89
NONNEIGHBORS	< 0.1% (-60 dB)	--	-59 TO -64	--	-58 TO -66	--	-60 TO -61	--	-58 TO -72

*CH 7 0.1 dB TOO HIGH AT 20 kHz

9/82

21170-202

PRIME FPA FAILURE REPORT SUMMARY

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	NUMBER OF FAILURES
50799 SUBSTRATE ASSY AND TEST	0
51015 HALFBAND ASSY & TEST	12
50797 BAND LEVEL ASSY AND TEST	8
50807 LED ASSY AND TEST	0
50795 PRIME FPA ASSY AND TEST	2
UNIT LEVEL VIBRATION	0
	CUMULATIVE TOTAL = 122

9/82
21170-170

PRIME FPA RDW SUMMARY

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DESCRIPTION	NUMBER
USE OF UNAPPROVED PARTS (LED CHIPS)	1
OUT OF SPECIFICATION PERFORMANCE	11
LEAD-TO-LEAD WIRE WRAP SOLDERING ON LED ASSY	1
TOTAL	13

CFPA WITH CABLES
50973

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BAND 5, 6, AND 7 VIDEO CHANNELS

PHOTON FLUX FROM TELESCOPE

⇩

50973 COLD FOCAL PLANE WITH CABLES

⇩

50980 PREAMP MODULE

⇩ 51843 BAND 5 PREAMP

⇩ 50984 BAND 6 PREAMP

⇩ 50988 BAND 7 PREAMP

50808-1
50912
50908
} POSTAMPLIFIERS

⇩

TO MUX

9/82
21170-174

COOLED FOCAL PLANE ARRAY WITH CABLES

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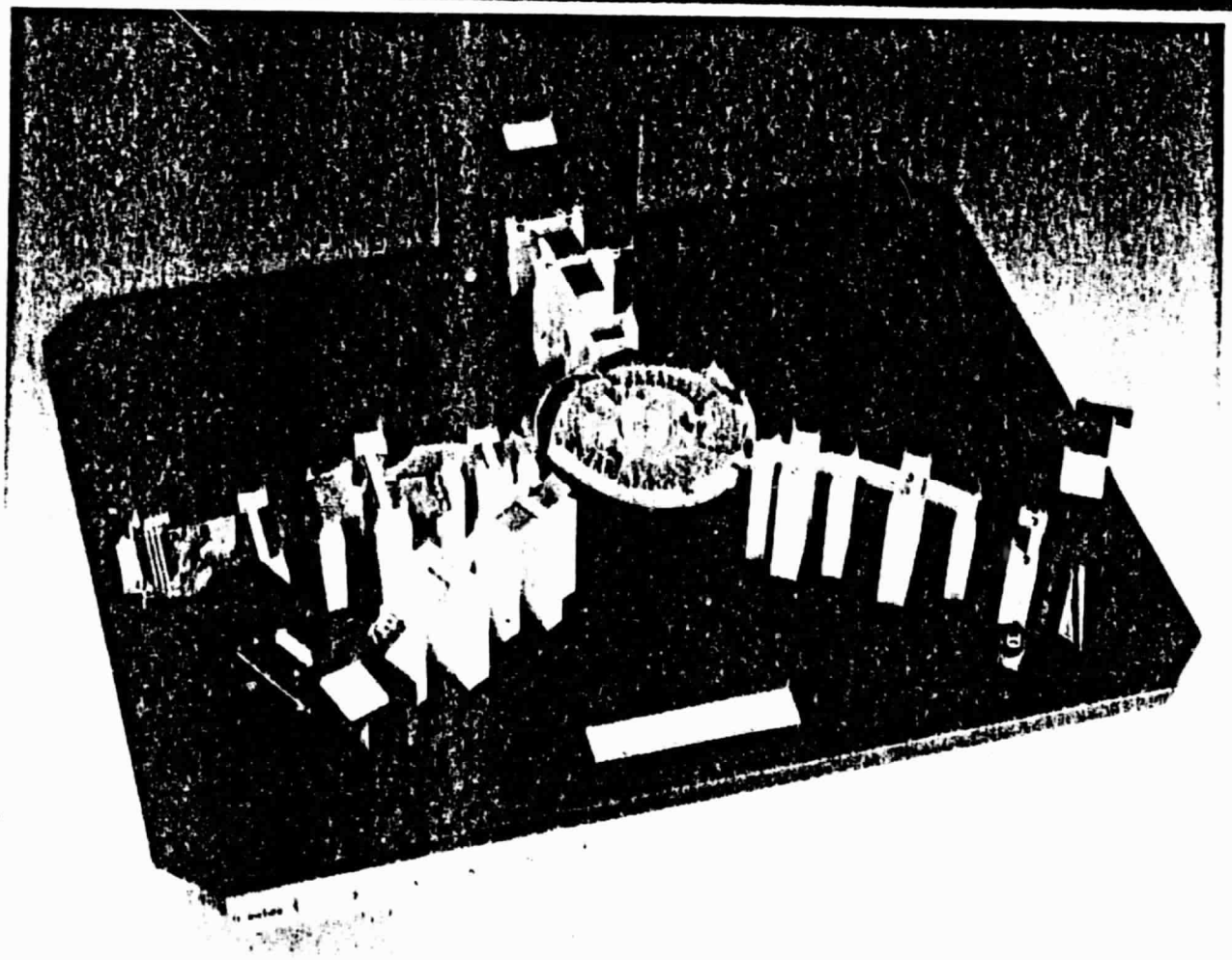
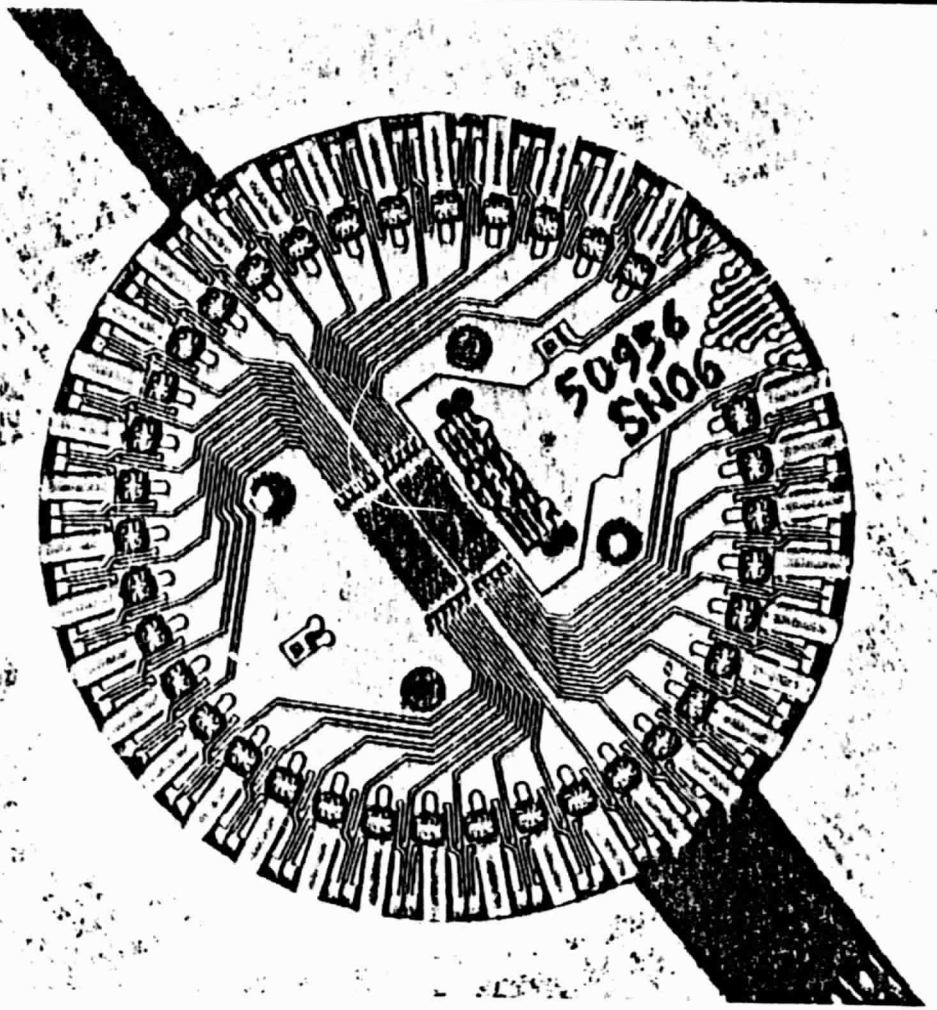


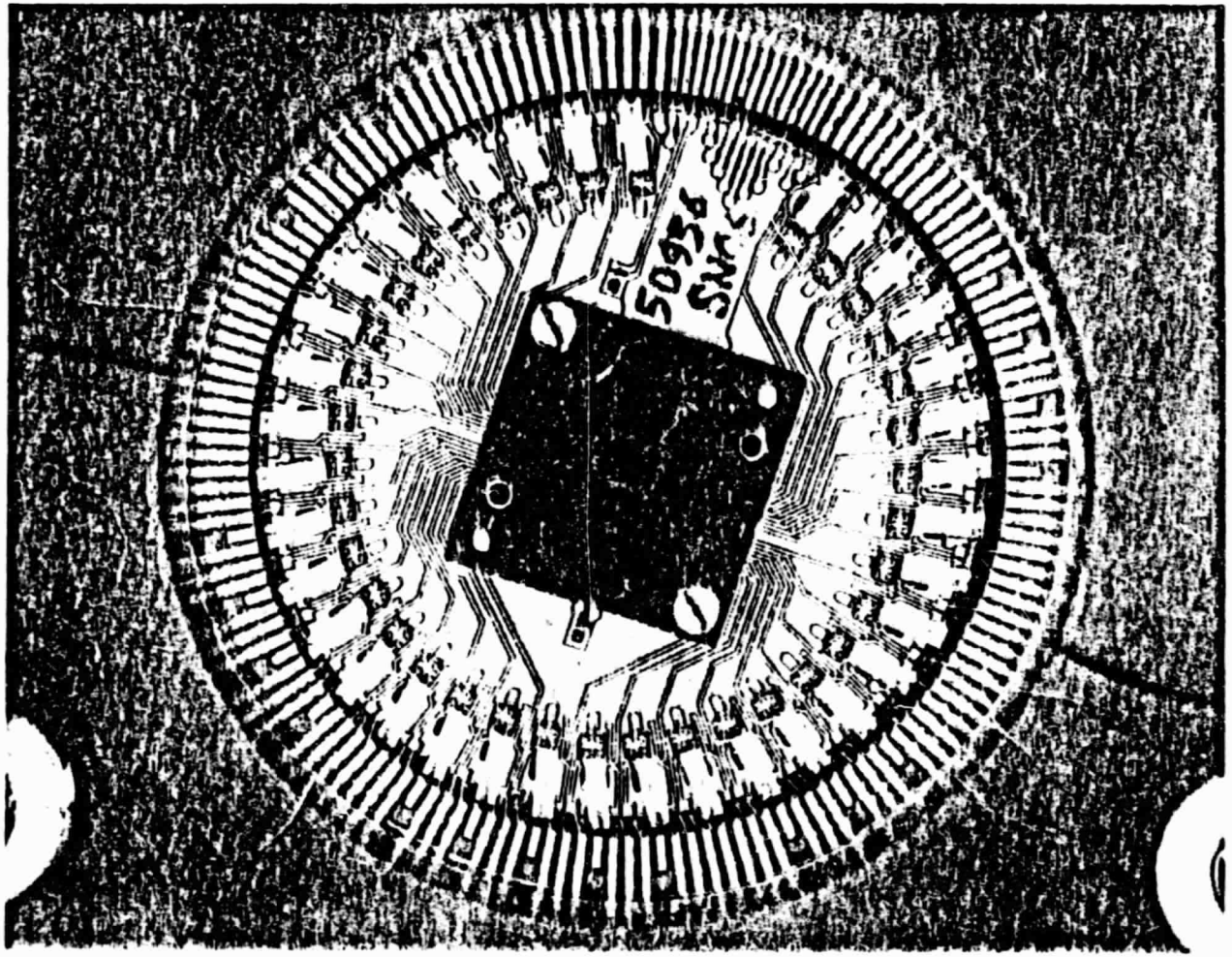
9/82
21170-173

CFPA WITHOUT FILTER ASSEMBLY



CFPA WITH FILTER ASSEMBLY

SBRC



CFPA WITH CABLES
50973

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HUGHES AIRCRAFT COMPANY

FUNCTION

- TRANSDUCER CONVERTS INCOMING PHOTON FLUX TO ELECTRICAL SIGNALS THAT MAY BE AMPLIFIED AND PASSED ON TO MUX

CRITICAL PARAMETERS

- SIGNAL-TO-NOISE RATIO AS REQUIRED BY SYSTEM SPEC
- FLAT FREQUENCY RESPONSE TO 52 KHz WHEN TESTED WITH POSTAMPLIFIER (±0.5 dB)
- SETTLING TIME TO 1% WITHIN 60 µS, 1.5% WITHIN 30 µS
- LOW CHANNEL-TO-CHANNEL INTERACTION (< -40 dB)

REQUIREMENT CHANGES SINCE DDR

- NONE

CFPA WITH CABLES
50973

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HUGHES AIRCRAFT COMPANY

DESIGN CHANGES SINCE DDR

- ADDED SHIELDS, 52808 AND 52809, TO REDUCE CROSSTALK
- * GOLD WIRE (0.001 IN. DIA) CONNECTS TO DISTRIBUTION BOARD INSTEAD OF PT (0.001 IN. DIA)
- CABLE ATTACHMENT REINFORCED BY SPOT BONDING AT DISTRIBUTION BOARD TERMINALS
- * CABLE PAD REDESIGN TO REDUCE FATIGUE (SEE FR F0592)
- DELETED GUARD RESISTORS AND ADDED CHIP CAPACITORS (52928) ACROSS FEEDBACK RESISTORS TO IMPROVE BANDS 5 AND 7 FREQUENCY RESPONSE
- CHANGED FROM ELTEC 114 FEEDBACK RESISTORS TO MSR-3 TO IMPROVE FREQUENCY RESPONSE
- RESISTORS PLACED ON 0.020 IN. THICK SAPPHIRE STANDOFFS TO REDUCE CAPACITANCE TO GROUND AND IMPROVE FREQUENCY RESPONSE

*DESIGN CHANGE NOT INCORPORATED IN ENGINEERING MODEL

CFPA WITH CABLES
50973

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ENVIRONMENTAL TESTS

- 20 THERMAL CYCLES BETWEEN 77 AND 300K
- VIBRATION TEST CONDUCTED IN RADIATIVE COOLER

STATUS / PROBLEMS

- COMPLETE THROUGH PROTOFLIGHT AND FLIGHT
- VIBRATION TEST CONDUCTED IN RADIATIVE COOLER

COOLED FPA FLOW CHART

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50955
CFPA ASSY & TEST

50973
CFPA/CABLES
ASSY & TEST

TEST AND
REWORK

TEST WITH
PREAMPS AND
POSTAMPS

INTEGRATE WITH
RADIATIVE
COOLER

VIBRATION
TESTING

THERMAL VAC
TESTING BAND 6

SYSTEM TESTING
WITH BTCE

SYSTEM
THERMAL VAC
TESTING

9/82
21170-182

BANDS 5 AND 7 DATA SUMMARY

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ITEM		BAND 5		BAND 7	
	SPEC	$\bar{X}$	RANGE	$\bar{X}$	RANGE
FREQUENCY/TRANSIENT RESPONSE					
SETTLING TIMES, μSEC 1.5%	<30	25	20 TO 30	28	26 TO 32
1.0%	<60	34	30 TO 40	32	29 TO 47
OVERSHOOT, %	<10	9.3	7.2 TO 11.5	8.0	3 TO 11
FREQUENCY RESPONSE, dB	$-3^{-0}+0.5$ AT 52 kHz	-2.8	-2.0 TO -3.2	3.0	-2.6 TO -3.3
	FLAT ±0.5 dB		PASSED		PASSED
RISE TIME, μSEC	<20	11.9	11.0 TO 14.0	11.8	11.0 TO 15.0
TIME DELAY, μSEC LEADING	TBD ± 0.5	12.2	11.6 TO 12.4	12.3	11.8 TO 13.0
TRAILING		12.8	12.2 TO 13.8	12.8	12.2 TO 13.4
R_λ BAND 5, A/W	>0.8	1.4	1.3 TO 1.5	--	--
R_λ BAND 7, A/W	>1.0	--	--	1.8	1.7 TO 2.0
NEP_λ BAND 5, W	$<5.8\times10^{-12}$	3.3×10^{-12}	$(2.9 \text{ TO } 3.1)\times10^{-12}$	--	--
NEP_λ BAND 7, W	$<4.8\times10^{-12}$	--	--	2.4×10^{-12}	$(2.0 \text{ TO } 3.2)\times10^{-12}$

9/82
21170-180

BAND 6 DATA SUMMARY

SBRC

ITEM	SPEC	$\bar{X}$	RANGE
FREQUENCY AND TRANSIENT RESPONSE, μSEC			
SETTLING TIMES 1.5%	<120	NOT AVAILABLE	NOT AVAILABLE
1.0%	<120	NOT AVAILABLE	NOT AVAILABLE
OVERSHOOT, %	<10	NOT AVAILABLE	NOT AVAILABLE
FREQUENCY RESPONSE, dB	-3-0+0.5 AT 13 kHz	2.8	2.7 TO 2.9
RISE TIME, μSEC	<80	NOT AVAILABLE	NOT AVAILABLE
TIME DELAY, μSEC			
LEADING	--	30	30 TO 30
TRAILING	--	38	38 TO 38
DROOP, %	<0.4	NOT AVAILABLE	NOT AVAILABLE
R_λ, V/W	>3200	9.7×10^{3}	$(7.7 \text{ TO } 11.7)\times10^{3}$
NEW_λ, W	$<0.93\times10^{-10}$	0.44×10^{-10}	$(0.37 \text{ TO } 0.51)\times10^{-10}$

9/82
21170-181

COOLED FPA FAILURE REPORT SUMMARY

SBRC
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HUGHES AIRCRAFT COMPANY

	NUMBER OF FAILURES
50955 CFPA ASSY AND TEST	0
50973 CFPA/CABLES ASSY AND TEST	0
TEST AND REWORK	14
TEST WITH PREAMPS AND POSTAMPS	2
INTEGRATE WITH RADIATIVE COOLER	1
VIBRATION TESTING	0
THERMAL VAC TESTING BAND 6	0
SYSTEM TESTING WITH BTCE	0
SYSTEM THERMAL VAC TESTING	0

CUM TOTAL = 17

9/82
21170-183

COOLED FPA RDW SUMMARY

SBRC
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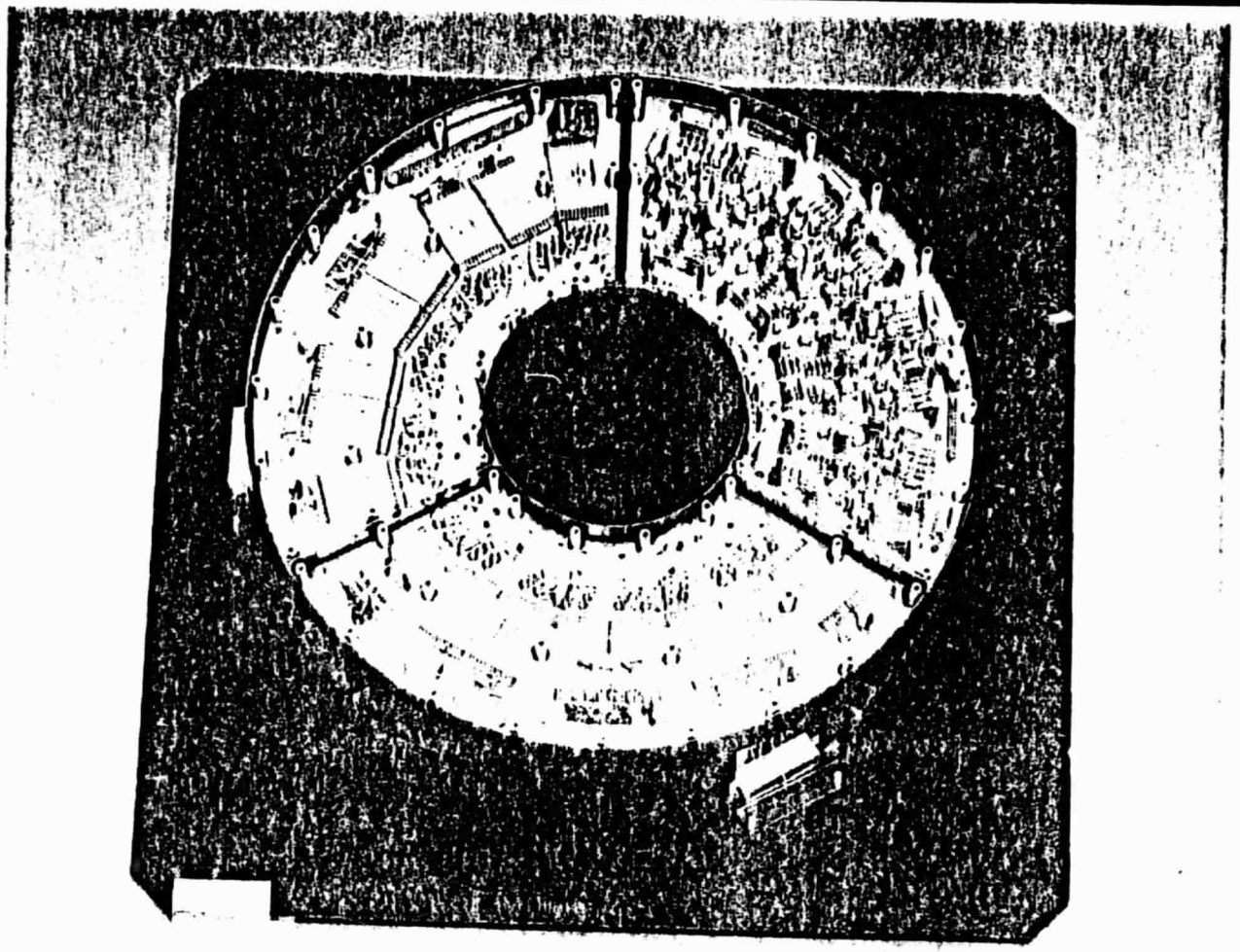
HUGHES AIRCRAFT COMPANY

DESCRIPTION	NUMBER
InSb DETECTOR RELATED	9
NONCONFORMING PARTS	2
OUT OF SPECIFICATION PERFORMANCE	1
UNRELEASED HcT DETECTOR PLANNING	1
TOTAL	13

COOLED PREAMPLIFIER MODULE

SBRC

A SUBSIDIARY OF HUGHES AIRCRAFT COMPANY



9/82
21170-186

BAND 7 PREAMPLIFIER

SBRC

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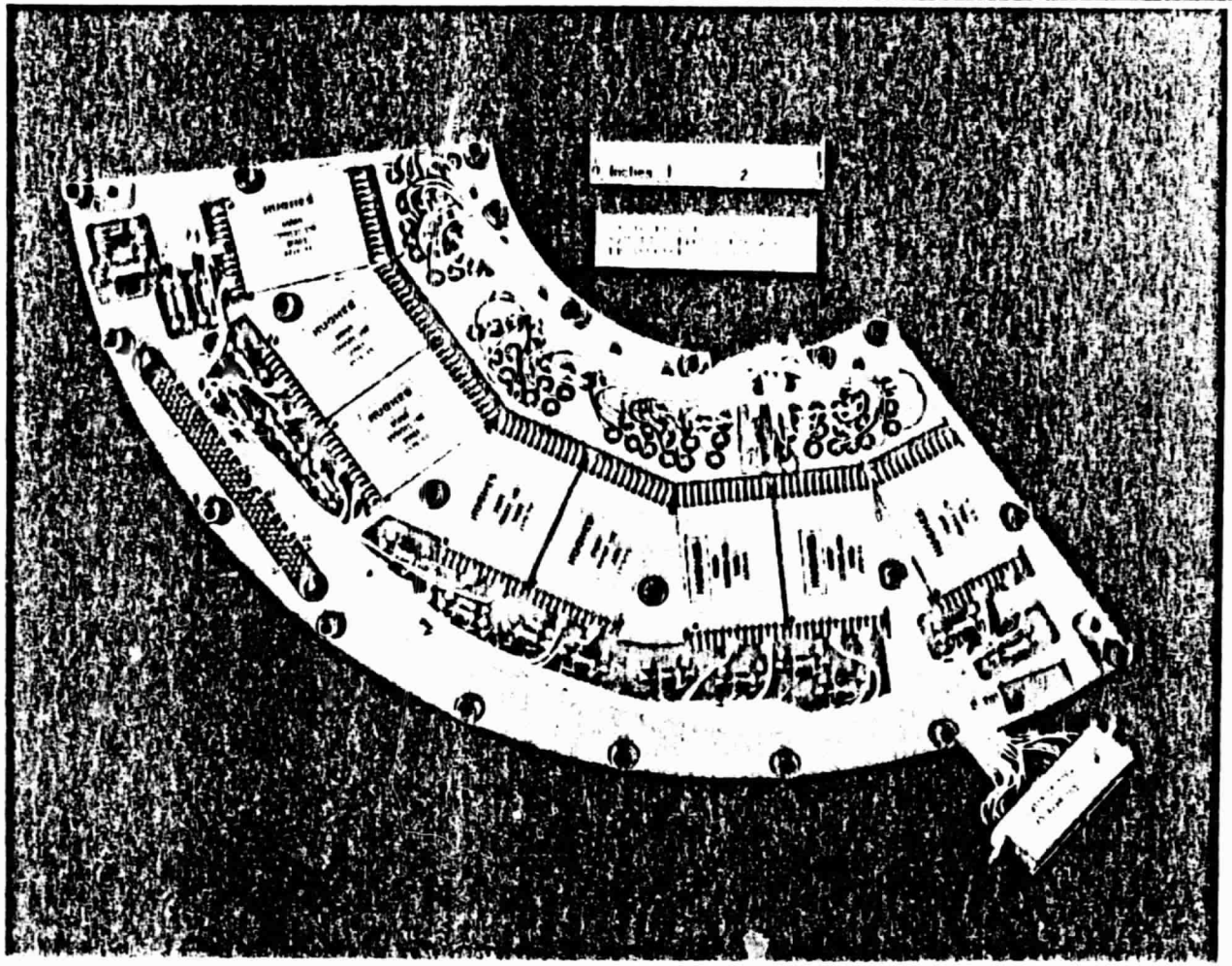

BANDS 5 AND 7 PREAMPLIFIERS 50988 AND 51843

SBRC
A SUBSIDIARY OF HUGHES AIRCRAFT COMPANY

FUNCTION

- PROVIDE HIGH VOLTAGE GAIN AND WIDE BANDWIDTH SO FREQUENCY RESPONSE DETERMINED BY FEEDBACK RESISTOR ONLY

CRITICAL PARAMETERS

- HIGH GAIN (x1000)
- LOW INPUT NOISE (4.2 $nV/\sqrt{Hz}$)
- OPEN LOOP -3 dB FREQUENCY RESPONSE > 5 KHz

REQUIREMENT CHANGES SINCE DDR

- FREQUENCY RESPONSE REQUIREMENT MODIFIED TO MATCH CHARACTERISTICS OF FOCAL PLANE

BANDS 5 AND 7 PREAMPLIFIERS 50988 AND 51843 (CONT)

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HUGHES AIRCRAFT COMPANY

DESIGN CHANGES SINCE DDR

- ADDED INPUT BALANCE RESISTORS R2-R17 WITH BYPASS CAPACITORS C3-C18 ALLOWS DETECTOR BIAS TO BE SET TO ZERO ± 10 mV
* • PWB RELAYED OUT TO PROVIDE SHIELDING OF FEEDBACK LEADS TO REDUCE TENDENCY TO OSCILLATE
- ADDED CAPACITORS C19-C34 TO SUPPRESS LOOP OSCILLATION
- CHANGED R18 FROM 22.1K TO 10K TO IMPROVE BIAS STABILITY SITH TEMP
- CHANGED CR1 FROM IN5306 TO IN5305 TO IMPROVE BIAS STABILITY WITH TEMP
- CHANGED RESISTOR CONNECTION AT INPUT OF AR1 AND AR3
- TRADED MORE BANDWIDTH FOR LOW FREQUENCY STABILITY
- REMOVED INPUT STAGE FREQUENCY COMPENSATION
- CHANGED C3 FROM 39 TO 430 pF TO ACCOMMODATE FOCAL PLANE FREQUENCY RESPONSE
- CHANGED Q3 FROM LM194 TO LM114 FOR INCREASED BANDWIDTH
- CHANGED Q1 AND Q2 FROM 2N4405 TO 2N3811 FOR BETTER DETECTOR BIAS STABILITY AT EXPENSE OF SLIGHT NOISE INCREASE

*DESIGN CHANGE NOT INCORPORATED IN ENGINEERING MODEL

BANDS 5 AND 7 PREAMPLIFIERS 50988 AND 51843 (CONT)

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HUGHES AIRCRAFT COMPANY

ENVIRONMENTAL TESTS

- TESTED AT -15° AND 35°C
- BURNED IN AT 85°C PER 16107
- TESTED AT 30°C AND -5°C
- TEMPERATURE CYCLED FROM -25 TO 40°C PER 16382

STATUS / PROBLEMS

- FABRICATED THROUGH PROTOFLIGHT

BAND 6 PREAMPLIFIER

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9/82
21170-190

BAND 6 PREAMPLIFIER
5098A

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FUNCTION

- TO SUPPLY STABLE BIAS CURRENT TO DETECTOR AND AMPLIFIER RESULTING DETECTOR VOLTAGE SIGNAL, ADDING VERY LITTLE NOISE

CRITICAL PARAMETERS

- LOW NOISE ($< 1\ nV/\sqrt{Hz}$)
- HIGH, STABLE GAIN (500)
- LONG AC TIME CONSTANT (16S)

REQUIREMENTS CHANGES SINCE DDR

- ADDED SINGLE POLE FILTER, ORIGINALLY INTENDED FOR POSTAMP

ALIGNMENT AND FOCUS MECHANISM

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FUNCTION

- PROVIDE CAPABILITY FOR ATTAINING AND MAINTAINING REGISTRATION (WITH RESPECT TO PRIME FOCAL PLANE)

DESIGN

- THREE BURLEIGH INDUSTRIES INCHWORMS USED TO CONTROL TILT AND TRANSLATION OF SPHERICAL RELAY MIRROR
  - RESOLUTION: 1 STEP = 98 μ IN., 1/20 IFOV ALIGHMENT
  - NORMALLY LOCKED WITHOUT POWER TO 23 G'S (EXPECTING 28 G'S AT QUAL LEVEL)

CHANGES SINCE PFR

- NONE

ANALYSIS/TEST

- DESIGN VERIFIED BY PF QUALIFICATION TEST
- QUAL TEST COMPLETE (HS 236-6698)
- HOLDING FORCE IS 15 LB ≈ 23 G'S
- PUSHING FORCE IS 4 LB; 1.5 LB MAX REQUIRED

STATUS

- F1 COMPLETED

MODEL PERFORMANCE DIFFERENCES

- PF - INCHWORM HOLDING FORCE 20 LB EACH
- F1 - INCHWORM HOLDING FORCE 15 LB EACH

BAND 6 AMPLIFIER 5098A (CONT)

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HUGHES AIRCRAFT COMPANY

DESIGN CHANGES SINCE DDR

- ADDED C14-15 AND CHANGED VALUE OF R41 AND R44 TO ADD REAL POLE IN GOLD-BURG FILTER
- REPLACED ZENER DIODE-CURRENT SOURCE COMBINATION WITH RESISTOR DIVIDER FOR LOWER NOISE (R45-48)
- ADDED E8 AND R49 TO MONITOR BALANCE ADJUSTMENT IN ENVIRONMENTAL CHAMBER
- CHANGED C8 FROM 120 PF TO 470 PF FOR LOOP STABILITY
- CHANGED Q12 FROM LM194 TO LM114 TO FOLLOW SAME CHANGE IN BANDS 1 THROUGH 4, 5, AND 7 PREAMPS
- CHANGED CONNECTION OF R30, R35, AND VALUE OF R34 AND R38 TO INCREASE LOOP GAIN WHICH REDUCES SAG DURING SCAN
- CONNECTED DETECTOR RETURN TO BAND 5 DETECTOR RETURN AND DISCONNECTED BAND 6 DETECTOR RETURN TO POSTAMP TO REDUCE NOISE PICKUP ON BAND 5

C-2

BAND 6 AMPLIFIER 5098 (CONT)

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HUGHES AIRCRAFT COMPANY

ENVIRONMENTAL TESTS

- TESTED AT +30°C AND -5°C
- TEMP CYCLE FROM -25 TO +40°C PER 16378

STATUS / PROBLEMS

- FABRICATED THROUGH PROTOFLIGHT

DEVIATIONS / WAIVERS

- D-041 TO ADD BALANCE ADJUSTMENT MONITOR

50980 COOLED PREAMP MODULE FLOW CHART

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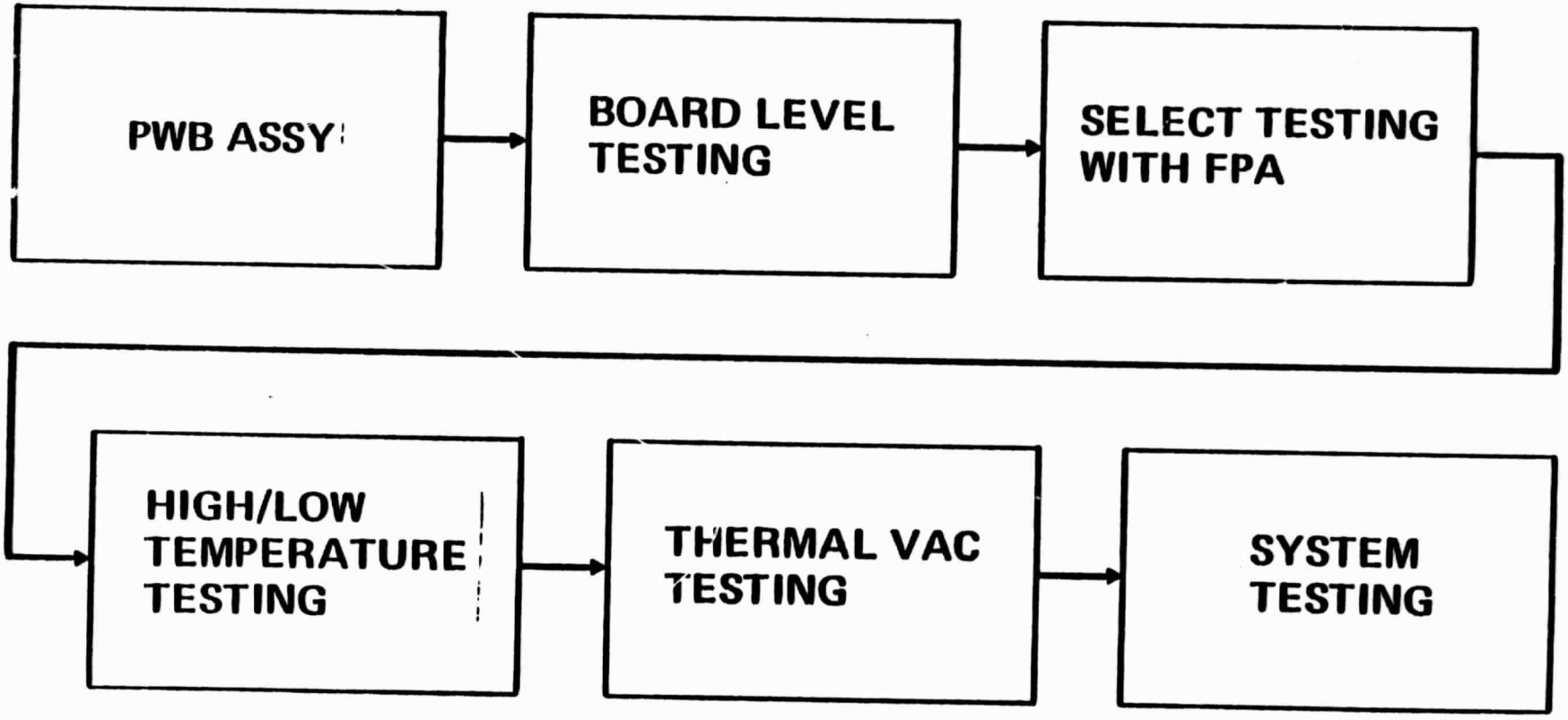

9/82
21170-194

50980 COOLED PREAMP MODULE FAILURE REPORT SUMMARY

SBRC
A SUBSIDIARY OF HUGHES AIRCRAFT COMPANY

	NUMBER OF FAILURES
PWB ASSY	0
BOARD LEVEL TESTING	3
SELECT TESTING WITH FPA	2
HIGH/LOW TEMPERATURE TESTING	0
THERMAL VACUUM TESTING	0
SYSTEM TESTING	0
	CUMULATIVE TOTAL = 5

9/82
21170-195

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50980 COOLED PREAMP MODULE WAIVER SUMMARY

DESCRIPTION	NUMBER
CUTS AND JUMPERS	7

9/82
21170-196

POSTAMPLIFIER ASSEMBLY
50904

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HUGHES AIRCRAFT COMPANY

FUNCTION

- PROVIDE 16 CHANNELS (1 BAND) OF VIDEO SIGNAL GAIN AND FREQUENCY SHAPING
- PROVIDE REGULATED PREAMP POWER
- CONTAINS COMMAND AND TELEMETRY RELAYS

CRITICAL PARAMETERS

- REGULATED VOLTAGE AS FUNCTION OF LINE VOLTAGE
- UNIFORM CHANNEL-TO-CHANNEL GAIN AND FREQUENCY RESPONSE
- LOW DC OFFSET

REQUIREMENTS CHANGES SINCE DDR

* • PREGAIN SELECT TRIM
* • ROLLOFF SELECT TRIM
- HYBRID CIRCUIT (50859)
  - GAIN AND FREQUENCY RESPONSE REQUIREMENTS HAVE BEEN REVISED PERIODICALLY AS FOCAL PLANE CHARACTERISTICS AND SYSTEM REQUIREMENTS BECAME FIRMLY ESTABLISHED

* DESIGN CHANGE NOT INCORPORATED IN ENGINEERING MODEL

POSTAMPLIFIER ASSEMBLY 50904 (CONT)

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HUGHES AIRCRAFT COMPANY

DESIGN CHANGES SINCE DDR

* • ADDED PREGAIN SELECT RESISTORS R81-R96

* • ADDED ROLLOFF SELECT RESISTORS R65-R80

- ADDED KLEEBURG CAPACITORS C57-C72
- ADDED OFFSET TRIM RESISTORS, R97-R112
- REMOVED REGULATOR CURRENT LIMITING RESISTORS TO ELIMINATE POSSIBILITY OF REGULATOR NOT COMMING UP
- HYBRID CIRCUIT (50859) CHANGES
  - ADDED PREGAIN TERMINALS TO PROVIDE INCREASED GAIN SELECTIVITY (TM 366)
  - SPECIFIED R_2C_1 = T, RATHER THAN INDIVIDUAL COMPONENTS TO EXPEDITE CAPACITOR PROCUREMENT (TM 383)
  - ADDED ROLLOFF TERMINALS TO COMPENSATE FOR PREAMP AND POSTAMP FREQUENCY RESPONSE VARIATIONS AROUND 50 KHz (TM 444)

** • ADDED 16 RESISTORS TO BAND 1 POSTAMP ASSY TO ELIMINATE COHERENT NOISE PER 7R5779

* DESIGN CHANGES NOT INCORPORATED IN ENGINEERING MODEL
** DESIGN CHANGE NOT IN P7 MODEL

POSTAMPLIFIER ASSEMBLY 50904 (CONT)

SBRC
A SUBSIDIARY OF HUGHES AIRCRAFT COMPANY

STATUS / PROBLEMS

- BUILT AND TESTED THROUGH PROTOFLIGHT
- KLEEBURG EFFECT; ADDED CAPACITORS TO STOP OSCILLATION AND OUTPUT SHIFT; SEE FR 1706
- UNABLE TO SET OFFSET BIAS TO 1V AS RQD ADDED TRIM RESISTOR IN SERIES WITH OFFSET ADJUST RESISTOR; SEE FR 1761

ENVIRONMENTAL TESTS

- TEMP CYCLED -30° TO 60°C PER 16368
- TESTED AT 0° AND 50°C

POSTAMP FLOW CHART

SBRC

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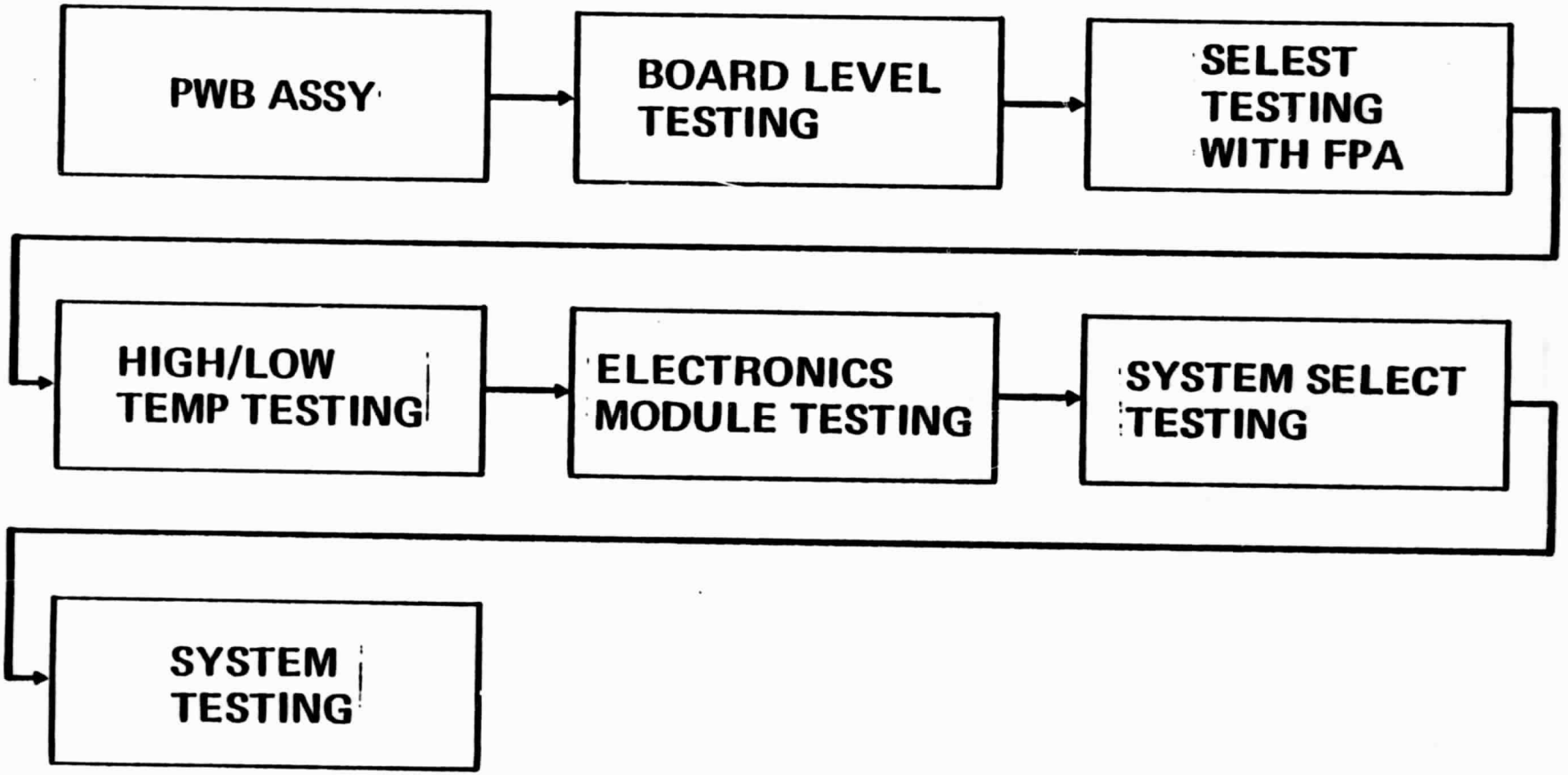

9/82
211 0-200

POSTAMP FAILURE REPORT SUMMARY

SBRC

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	NUMBER OF FAILURES
PWB ASSY	0
BOARD LEVEL TESTING	2
SELECT TESTING WITH FPA	17
HIGH/LOW TEMPERATURE TESTING	0
ELECTRONICS MODULE TESTING	0
SYSTEM SELECT TESTING	0
SYSTEM TESTING	0

CUMULATIVE TOTAL = 19

816597-79

9/82
21170-201

FOCAL PLANE SUMMARY

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PRIME FPA

- 40 CH MEETING SPEC AT SYSTEM LEVEL
- 24 CH OPERATING BUT NOT TO SPEC
- PERFORMANCE STABLE THROUGHOUT SYSTEM TESTING

COLD FPA

- 36 CH MEETING SPEC AT SYSTEM LEVEL
- WITH EXCEPTION OF BAND 5 CH 10, PERFORMANCE STABLE THROUGHOUT SYSTEM TESTING

BAND 5 CH 10 SIGNAL TO NOISE DEGRADATION

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HUGHES AIRCRAFT COMPANY

BAND 5 Ch 10 SHOWED x30% REDUCTION IN SIGNAL WITH APPROXIMATELY EQUAL INCREASE IN NOISE DURING THERMAL VAC. TESTING.

SUBSEQUENT TESTS WITH BENCH TEST COOLER SHOWED NORMAL PERFORMANCE.

BAND 5 CH 10 POSSIBLE SUBASSEMBLIES CONCERNED

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HUGHES AIRCRAFT COMPANY

- DETECTOR ASSEMBLY
- COOLER CABLE
- PRE AMPLIFIER
- INTERCONNECTION CABLE
- POST AMPLIFIER

BAND 5 CH 10
BAND 5 FPA HISTORY

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- PROBE TEST DATA TAKEN ON 11/13/81 SHOWED PERFORMANCE ANOMALY BELIEVED TO BE POOR TEST PROBE CONTACT

- ALL OTHER FPA ASSEMBLY LEVEL DATA SHOWS NORMAL PERFORMANCE

BAND 5 CH 10
RADIATIVE COOLER TEST RESULTS

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HUGHES AIRCRAFT COMPANY

- BAND 5 CHANNELS 9, 10, 12 AND BAND 7 CHANNELS 1, 2, 7, 10, 16 EXHIBITED HIGH NOISE / D.C. OFFSETS IN THERMAL VAC TESTS.
- INITIAL BENCH CHECKS SHOWED HIGH NOISE.
- NOISE PERFORMANCE OFFSETS RETURNED TO NORMAL VALUES WHEN WEAR SAVER WAS REPLACED.
- RETEST IN CHAMBER SHOWED NORMAL PERFORMANCE.

BAND 5 CH 10
STILL MORE THAN ONE EXPLANATION

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HUGHES AIRCRAFT COMPANY

- DETECTOR CHANGE - POSSIBLE, NOT CONSISTENT WITH DIFFERENCE BETWEEN CHAMBER AND BENCH TEST RESULTS.

- COOLER CABLE - THERMAL GRADIENT ACROSS CABLES DURING THERMAL VAC. $\Delta R \approx 200\Omega$ REQUIRED.

- PREAMP CONNECTOR - POST TEST FLEXING OF INTERFACE SHOWED NO CHANGES - POOR CONNECTION COULD CAUSE. PREAMP TEMP ESSENTIALLY SAME FOR DIAGNOSTIC TESTS IN CHAMBER AND BENCH TESTS.

BAND 5 CH 10 IMPLICATIONS

SBRC
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HUGHES AIRCRAFT COMPANY

- DETECTOR CURRENTLY EXHIBITS MARGINAL S / N RATIO ≈11.1
  MEASURED 13:1 SPECIFIED (MIN IRRADIANCE).

- ANY FURTHER DIAGNOSIS / REPAIRS REQUIRES REMOVAL,
  PROBABLE DISASSEMBLY OF RADIATIVE COOLER.

- DETECTOR / COOLER CABLE REPAIRS ENTAIL SIGNIFICANT RISK, TIME.

- FAILURE (OPEN OR SHORT) WOULD HAVE NO MEASURABLE IMPACT
  ON OTHER BAND 5 CHANNELS.

BAND 6
VIDEO LOSS-THE PROBLEM

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- DURING SPECIAL TEST BAND 6 VIDEO SIGNAL WAS ABSENT ALL CHANNELS - READ DC RESTORE LEVEL WITH NO NOISE.
- REEXAMINATION OF EARLIER TEST DATA SHOWED AT LEAST 3 OTHER TIMES WHEN BAND 6 EXHIBITED SIMILAR PERFORMANCE.
- PROBLEM WOULD NOT REPEAT FOR NEXT 5 ORBITS - SAME TURN-ON CONDITIONS.
- NO FURTHER OCCURRENCES DURING REMAINDER OF TEST.

BAND 6 VIDEO LOSS
POST AMP WIRING ERROR FOUND

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- FAILURE MECHANISM BELIEVED TO BE INSUFFICIENT CURRENT TO ALLOW PREAMPLIFIER TO ACHIEVE BALANCE AT TURN ON.
- PROBLEMS APPEAR RELATED TO LOW DUTY CYCLE, LARGE TRANSIENT (TURN ON SEQUENCE INDUCED) OPERATIONS.
- POST AMPLIFIER TROUBLESHOOTING SHOWED EARLIER MODIFICATION OF VOLTAGE REGULATOR INCORRECTLY IMPLEMENTED.
- INCORRECTLY WIRED SYSTEM IS INSTALLED IN PROTOFLIGHT MODEL.

BAND 6 VIDEO LOSS
AN ASSEMBLY DRAWING ERROR

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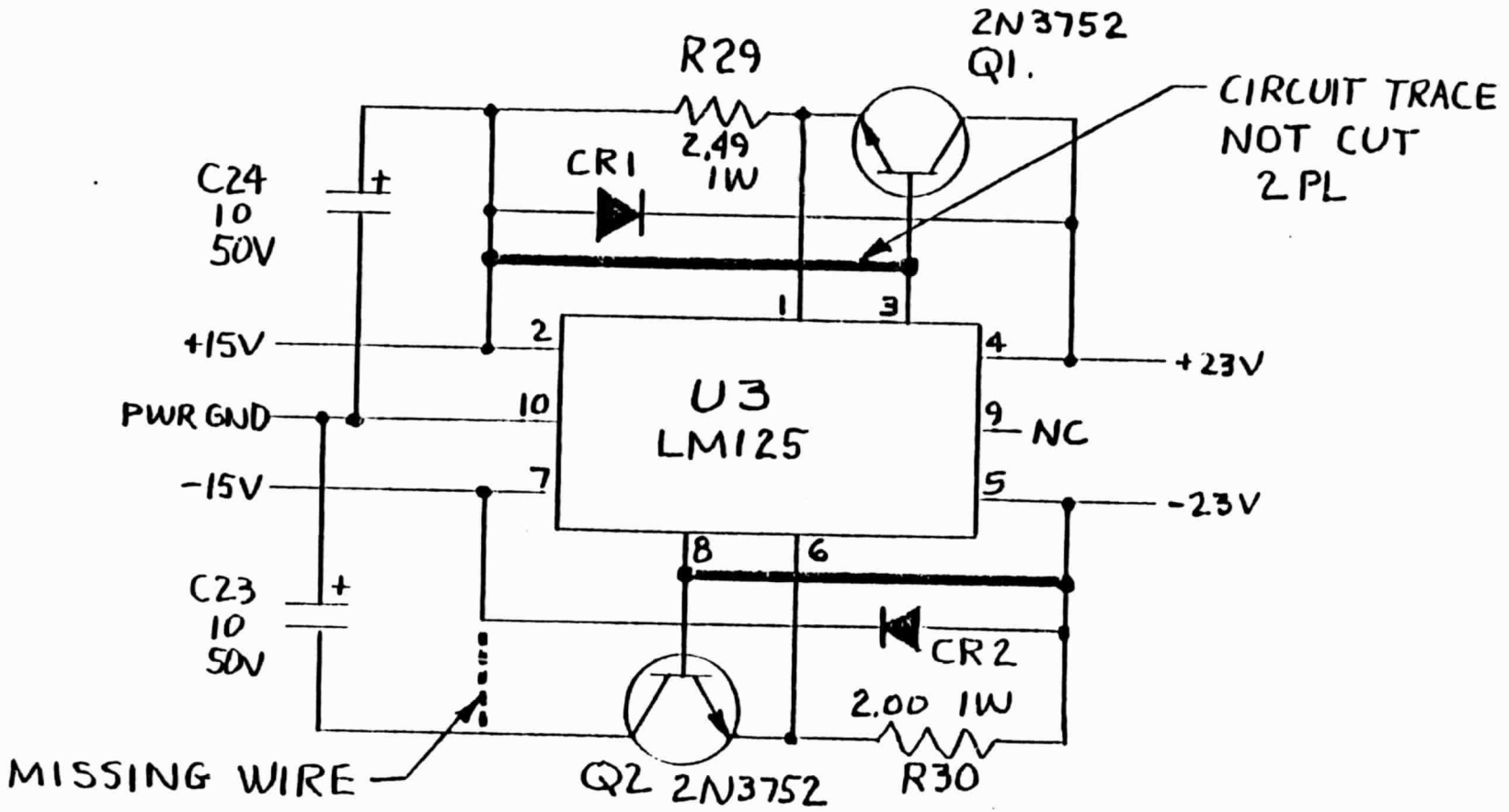

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BAND 6 VIDEO LOSS CONSEQUENCES

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- NO OVERSTRESS ON REGULATOR, OTHER COMPONENTS.
- CURRENT DRIVE INCREASED BY 90 M.A.
- MONITOR PERFORMANCE OVER EXTENDED PERIOD.
- EXAMINE CONSEQUENCES ON PROTOFLIGHT MODEL OPERATION.
- CONTINUE ANALYSIS EFFORT TO FURTHER DEFINE CONDITIONS REQUIRED.

RADIOMETER PERFORMANCE

21170-71

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RADIOMETER TOPICS

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- MAIN FRAME
- TELESCOPE
- AFT OPTICS
- RELAY OPTICS
- RADIATIVE COOLER DOOR/SHROUD
- RADIATIVE COOLER

MAIN FRAME

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FUNCTION

- INTERFACE WITH SPACECRAFT
- STRUCTURAL SUPPORT FOR:
  - OPTICAL ASSEMBLY
  - SCAN MIRROR ASSEMBLY (SMA)
  - ELECTRONICS MODULE

DESIGN

- 20 IN. DIAMETER ALUMINUM HONEYCOMB TUBE
- THREE BERYLLIUM BULKHEADS

CHANGES SINCE PFR

- NONE

MAIN FRAME (CONT.)

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ANALYSIS / TEST

- NASTRAN ANALYSIS COMPLETED AND VERIFIED BY SURVEY LEVEL SINE SWEEPS ON SMA TEST BED AND QUAL LEVEL TESTS ON PF

STATUS

- F1 - COMPLETED

MODEL PERFORMANCE DIFFERENCES

- NONE

TELESCOPE

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A SUBSIDIARY OF
HUGHES AIRCRAFT COMPANY

FUNCTION

- COLLECT SCENE ENERGY AND PRODUCE HIGH QUALITY DIFFRACTION LIMITED IMAGE

DESIGN

- STRUCTURE - LOW THERMAL EXPANSION MATERIALS:

  GRAPHITE EPOXY
  INVAR
  ULE MIRRORS

CHANGES SINCE PFR

- NONE

ANALYSIS / TEST

- DESIGN VERIFIED BY NASTRAN ANALYSIS AND PROTOFLIGHT MODEL QUALIFICATION TESTS

TELESCOPE (CONT.)

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STATUS

- F1 - COMPLETED

MODEL PERFORMANCE DIFFERENCES

- PRIMARY MIRROR LIP DAMAGED. ACCEPTABILITY VERIFIED BY PENALTY AND PERFORMANCE TESTING USING F1 MAIN FRAME

TELESCOPE TEST SEQUENCE

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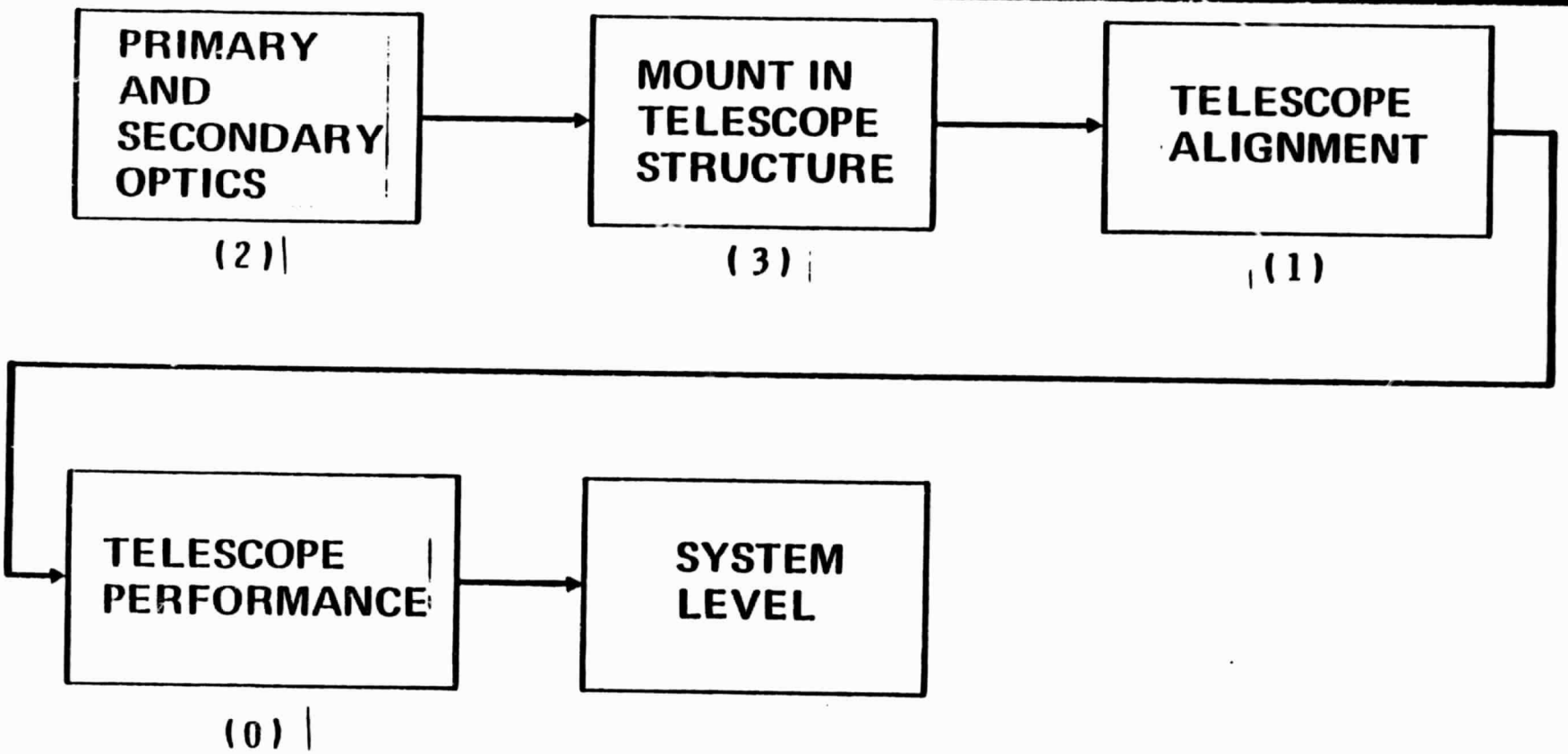

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AFT OPTICS ASSEMBLY

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FUNCTION

- CONTAINS SCAN LINE CORRECTOR, PRIME FOCAL PLANE ARRAY, PRIMARY AND REDUNDANT CALIBRATION / DC RESTORE SHUTTERS, CALIBRATION BLACKBODY

DESIGN

- STRUCTURAL BULKHEAD ALIGNED / PINNED TO TELESCOPE
- SLC ALGINED / PINNED TO BULKHEAD
- PFPA ALIGNED TO SLC / PINNED TO BULKHEAD
- SHUTTERS, BLACKBODY ALIGNED / PINNED TO BULKHEAD

CHANGES SINCE PFR

- NONE

AFT OPTICS ASSEMBLY (CONT.)

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ANALYSIS / TEST

- BULKHEAD DESIGN VERIFIED BY NASTRAN ANALYSIS AND PROTOFLIGHT MODEL QUALIFICATION TEST
- WORKMANSHIP VERIFIED BY VIBRATION OF AFT OPTICS ASSY (SBRC 16800)

STATUS

- F1 COMPLETED

MODEL PERFORMANCE DIFFERENCES

- NONE

SCAN LINE CORRECTOR (SLC)

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FUNCTION:

- MODIFY SCAN MOTION AT DETECTORS TO EQUALIZE OVER / UNDER LAP DUE TO BIDIRECTIONAL SCAN OF SMA

DESIGN

- TWO-PLANE, PARALLEL Be MIRRORS 45° WITH RESPECT TO OPTICAL AXES WHICH ROTATE AT CONSTANT RATE DURING ACTIVE SCAN; FAST RETRACE DURING SMA TURNAROUND
- LOW INERTIA Be MIRROR SUPPORT STRUCTURE AND MOVING COIL TORQUE MOTOR
- REDUNDANT TACHOMETERS TO PROVIDE RATE FEEDBACK

CHANGES SINCE PFR

- NONE

SCAN LINE CORRECTOR (CONT.)

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ANALYSIS / TEST

- DYNAMIC LINEARITY AND REPEATABILITY TEST RESULTS INDICATE IN SPEC PERFORMANCE
- QUAL AND LIFE TESTING COMPLETED
- FLEX PIVOTS 300 X 10^6 CYCLE LIFE TEST AT TSD COMPLETED

STATUS

- F1 - COMPLETED

MODEL PERFORMANCE DIFFERENCES

- NONE

PRIMARY ONBOARD CALIBRATION (OBC) SHUTTER

SBRC
A SUBSIDIARY OF
HUGHES AIRCRAFT COMPANY

FUNCTION

- PROVIDE DC RESTORE REFERENCE FOR ALL BANDS
- TRANSMIT ILLUMINATION FOR CALIBRATION OF BANDS 1 TO 5 AND 7
- TRANSMIT BLACKBODY ENERGY FOR CALIBRATION OF BAND 6

DESIGN

- LOW INERTIA RESONANT SHUTTER WHICH OSCILLATES IN SYNC WITH SMA
- FLEXURAL PIVOT SUSPENSION (NO LUBRICATION)
- TORSIONAL SPRING CONSTANT CONTROLLED BY EXTENSION SPRINGS
- SIX FIBER BUNDLES SIZED FOR PROPER ILLUMINATION IN BANDS 1 TO 5 AND 7
- CONCAVE MIRROR TO REFLECT BLACKBODY ENERGY TO BAND 6
- BLACK SHUTTER AREA FOR DC RESTORE

CHANGES SINCE PFR

- NONE

PRIMARY OBC SHUTTER (CONT.)

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ANALYSIS / TEST

- REVISED DESIGN VERIFIED BY QUAL LEVEL VIBRATION ON LIFE TEST MODEL AND PF O.B.C. AND ON PF INSTRUMENT QUALIFICATION TEST
- CALIBRATION ILLUMINATION IMAGE QUALITY AND RADIANCE LEVEL VERIFIED AT UNIT LEVEL AND DURING PF TEST (SBRC 16707)
- FLEX PIVOT 180 X 10^6 CY LIFE TEST COMPLETE
- EXTENSION SPRING 180 X 10^6CY ACCELERATED LIFE TEST COMPLETE
- DEFLECTION BAND 180 X 10^6CY ACCELERATED LIFE TEST COMPLETE
- LIFE TEST MODEL 187 X 10^6CY LIFE TEST COMPLETE

STATUS / PROBLEMS

- F1 COMPLETED
- F1 SLIGHT OVERSHOOT ON STARTUP - DOES NOT AFFECT PERFORMANCE

MODEL PERFORMANCE DIFFERENCES

- NONE

REDUNDANT SHUTTER

SBRC
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HUGHES AIRCRAFT COMPANY

FUNCTION

- PROVIDE DC RESTORE REFERENCE FOR ALL BANDS IF PRIMARY SHUTTER FAILS

DESIGN

- IDENTICAL TO PRIMARY SHUTTER WITH FOLLOWING EXCEPTIONS:
  - TORSIONAL SPRING CONSTANT CONTROLLED BY FLEXURAL PIVOT, NOT EXTENSION SPRINGS
  - 2-POLE ROTOR IN LIEU OF 4-POLE ROTOR

CHANGES SINCE PFR

- NONE

ANALYSIS / TEST

- DESIGN VERIFIED BY QUAL LEVEL VIBRATION ON DEVELOPMENT MODEL SHUTTER AND ON PF QUALIFICATION TEST
- QUAL / LIFE TESTING TO BE BASED ON SIMILARITY TO PRIMARY SHUTTER

STATUS

- F1 COMPLETED

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CALIBRATION BLACKBODY

SBRC
A SUBSIDIARY OF
HUGHES AIRCRAFT COMPANY

FUNCTION

- PROVIDE BLACKBODY ENERGY FOR CALIBRATION OF BAND 6

DESIGN

- IDENTICAL TO VISSR / VAS BLACKBODY
- CONICAL CAVITY WITH DISCRETE RESISTIVE HEATERS

ANALYSIS / TEST

- DESIGN VERIFIED BY PF QUALIFICATION TEST
- FUNCTION VERIFIED BY THERMAL VACUUM ELECTRICAL TEST

CHANGES SINCE PFR

- NONE

MODEL PERFORMANCE DIFFERENCES

- NONE

STATUS

- F1 - COMPLETE

AFT OPTICS TEST SEQUENCE

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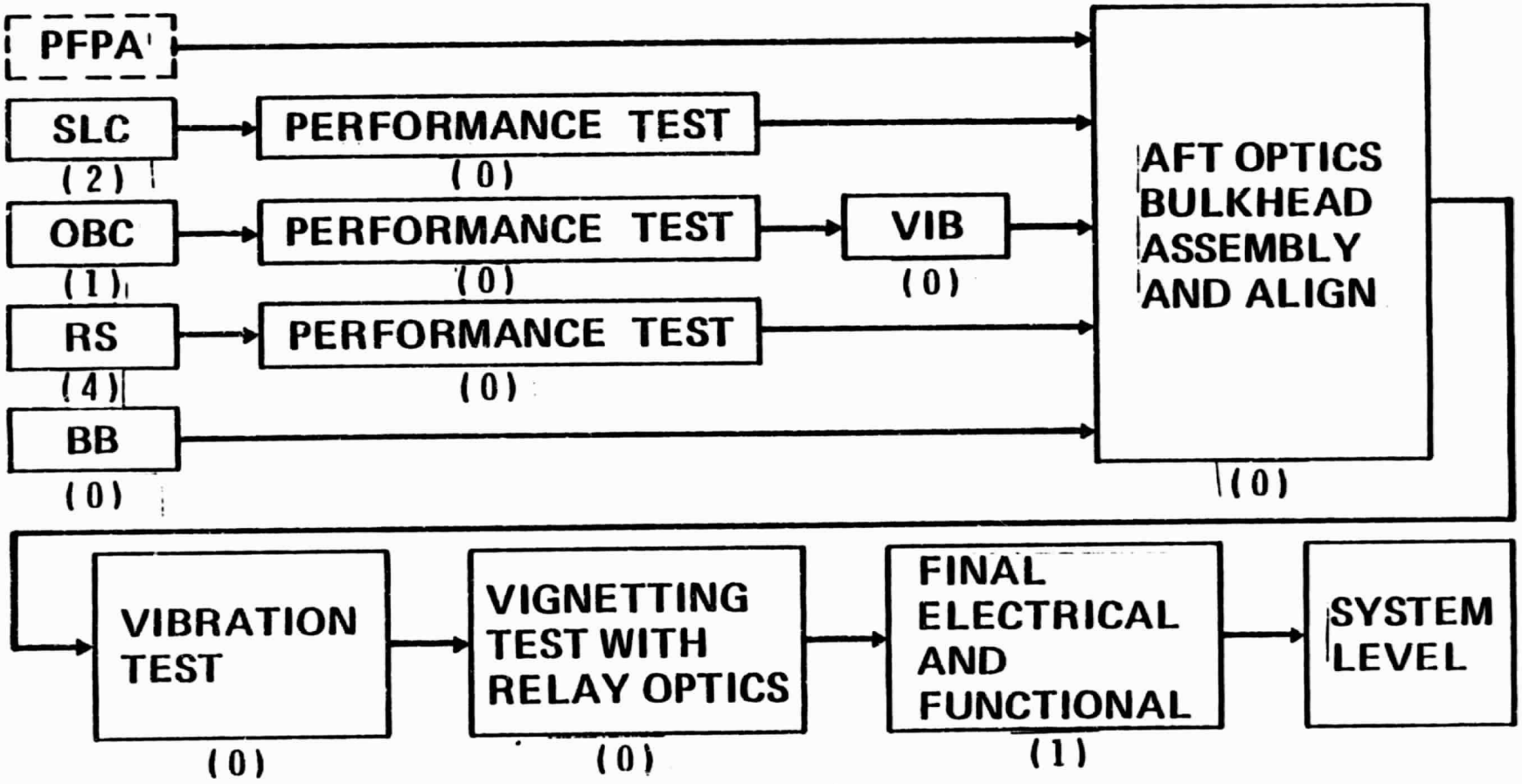

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AFT OPTICS MECHANISMS
PERFORMANCE F1

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	SPECIFICATION	ACTUAL
SLC	Q = 35 ± 5 f_N = 105 ± 5 Hz	Q = 38 f_N = 104.7 Hz
O.B.C.	Q = >90 f_N = 6.99 ± .014	Q = > 180 f_N = 6.99 Hz
REDUNDANT SHUTTER	Q = >48 f_N = 6.99 ± 0.014 Hz	Q = 50 f_N = 7.00 Hz

9/82
21170-87

RELAY OPTICS

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FUNCTION

- RELAY IMAGE FROM PRINE FOCAL PLANE TO BANDS 5, 6, AND 7 DETECTORS IN COLD FOCAL PLANE
- ALIGN OPTICAL AXIS WITH COOLER AXIS

DESIGN

- STRUCTURE - LOW THERMAL EXPANSION MATERIALS:

  GRAPHITE EPOXY
  INVAR
  ULE MIRRORS

- ACTIVE FOCUS / ALIGNMENT PROVIDED BY THREE INCHWORMS

CHANGES SINCE PFR

- NONE

ANALYSIS / TEST

- DESIGN VERIFIED BY NASTRAN ANALYSIS AND PEANLTY VIBRATION TEST ON AFT OPTICS BULKHEAD / RELAY OPTICS STRUCTURAL ASSEMBLY (HS 236-6585)

STATUS

- F1 - COMPLETED

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MODEL PERFORMANCE DIFFERENCES

ALIGNMENT AND FOCUS MECHANISM

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FUNCTION

- PROVIDE CAPABILITY FOR ATTAINING AND MAINTAINING REGISTRATION (WITH RESPECT TO PRIME FOCAL PLANE)

DESIGN

- THREE BURLEIGH INDUSTRIES INCHWORMS USED TO CONTROL TILT AND TRANSLATION OF SPHERICAL RELAY MIRROR
  - RESOLUTION: 1 STEP = 48 μ IN., 1/20 IFOV ALIGHMENT
  - NORMALLY LOCKED WITHOUT POWER TO 23 G'S (EXPECTING 28 G'S AT QUAL LEVEL)

CHANGES SINCE PFR

- NONE

ANALYSIS/TEST

- DESIGN VERIFIED BY PF QUALIFICATION TEST
- QUAL TEST COMPLETE (HS 236-6698)
- HOLDING FORCE IS 15 LB ≈ 23 G'S
- PUSHING FORCE IS 4 LB; 1.5 LB MAX REQUIRED

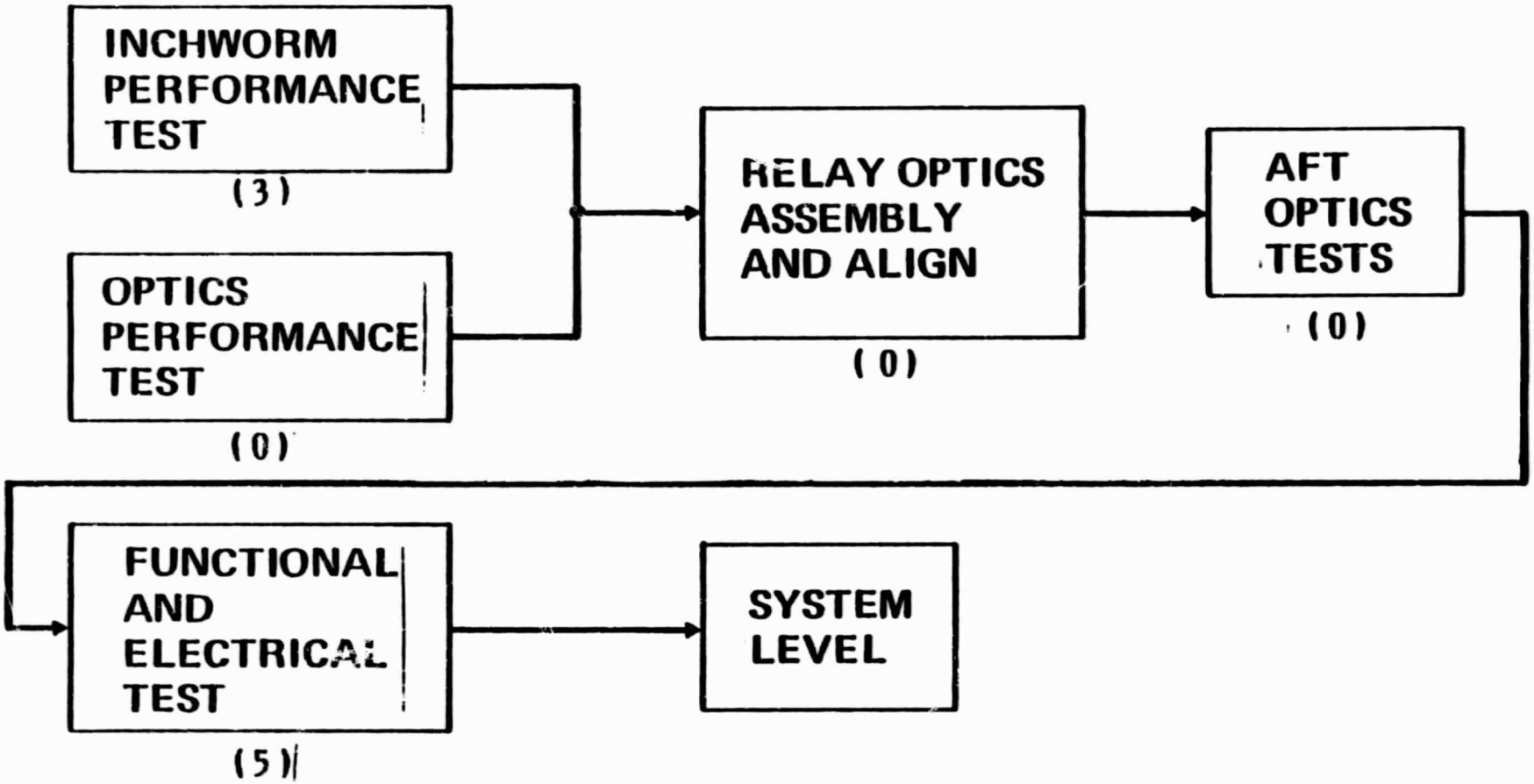
STATUS

- F1 COMPLETED

MODEL PERFORMANCE DIFFERENCES

- PF - INCHWORM HOLDING FORCE 20 LB EACH
- F1 - INCHWORM HOLDING FORCE 15 LB EACH

RELAY OPTICS TEST SEQUENCE



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RADIATIVE COOLER

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HUGHES AIRCRAFT COMPANY

FUNCTION:

PROVIDE COLD SPACE OPERATIONAL ENVIRONMENT FOR ALL COOLED FOCAL PLANE DETECTORS - BANDS 5, 6, AND 7

DESIGN

TWO-STAGE DEVICE WITH PASSIVE RADIATORS ON EACH STAGE

INTERMEDIATE STAGE OPERATES AT 145K

COLD STAGE TEMPERATURE CONTROLLED AT 90K, 95K, OR 105K

CHANGES SINCE PFR

MINOR DIMENSIONAL CHANGES TO INCREASE INTERSTAGE SEPARATION AND INSURE CLEARANCE DURING COOLDOWN

RADIATIVE COOLER LAYOUT

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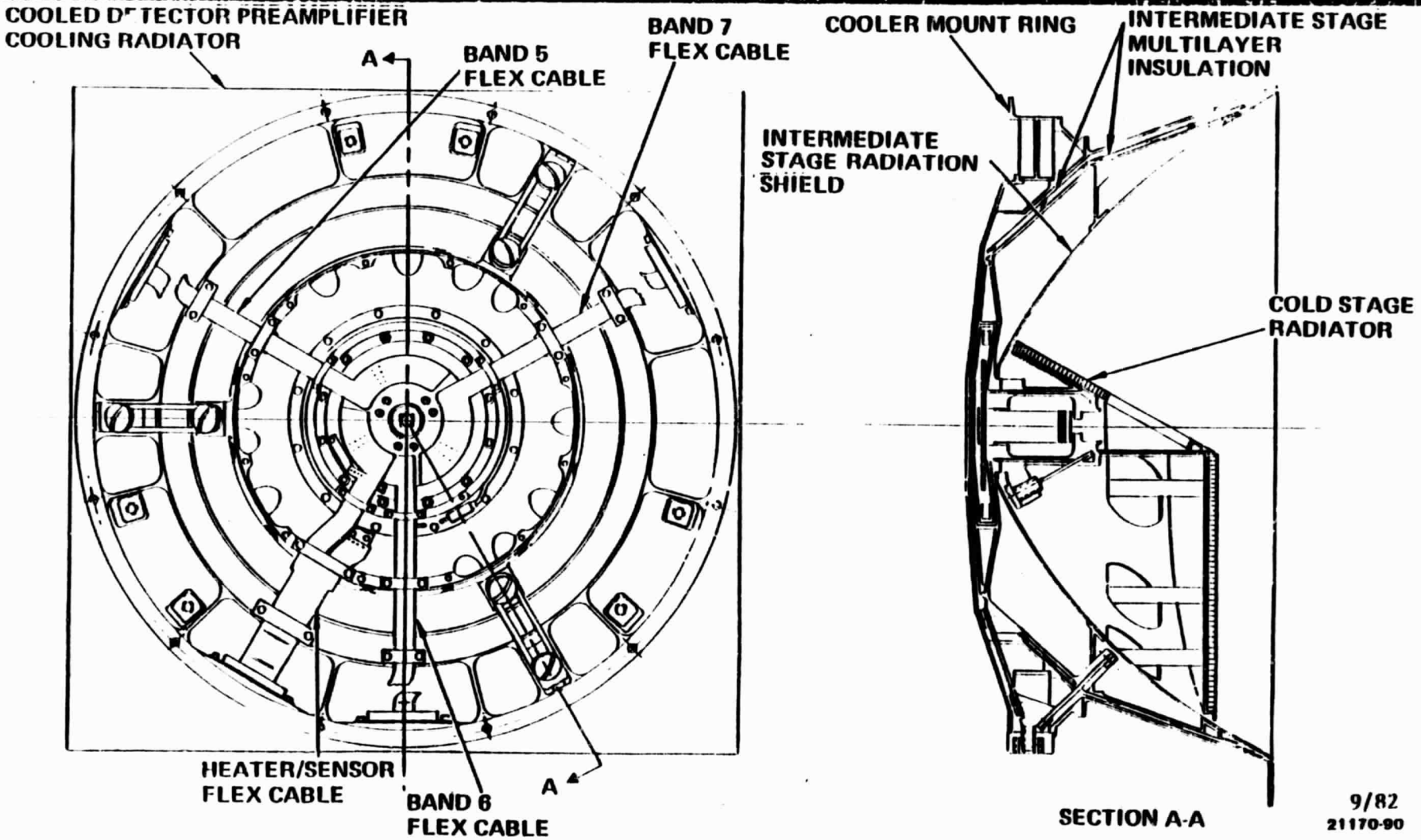

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RADIATIVE COOLER STATUS SUMMARY

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FABRICATION AND ASSEMBLY

- F1 COMPLETE

TEST

- STM VIBRATION TEST COMPLETE
- F1 THERMAL VACUUM TEST COMPLETE (HS236-7961)

RADIATIVE COOLER TEST SEQUENCE

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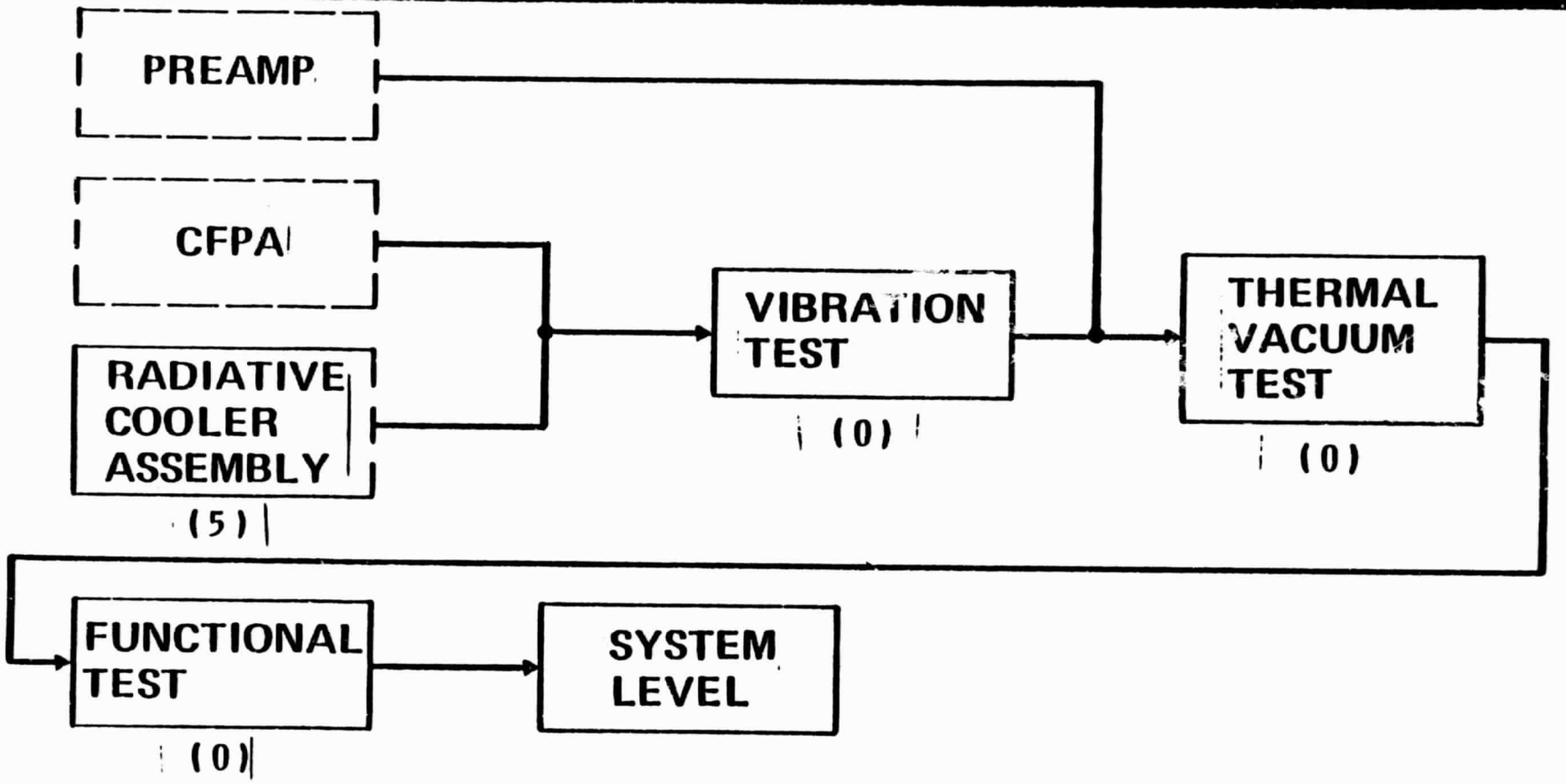

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RADIATIVE COOLER PERFORMANCE

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PARAMETER	REQUIREMENT	GSFC SPEC	TEST PERFORMANCE
THERMAL	8K SAFETY MARGIN, WITH WORST CASE ENVIRONMENTAL LOADING AND WITH 7TH BAND	3.3.3.1	CONFIRMED BY EM & PF COOLER TV TEST (84.5K VS 94K)
	5 MIN DIRECT SOLAR IMPINGEMENT WITHOUT DEGRADATION		CONFIRMED BY ANALYSIS
MECHANICAL	MECHANICAL INTEGRITY AND POSITION STABILITY AFTER VIBRATION, SHOCK AND ACOUSTIC EXPOSURE	3.3.3.2	CONFIRMED BY STM, PF, & F1 COOLER VIBRATION TESTS
DETECTOR MOUNTING SURFACE TEMPERATURE	SERVOSYSTEM DETECTOR TEMPERATURE CONTROL TO WITHIN ± 0.2K OF NOMINAL FLIGHT OPERATING TEMPERATURE	3.3.3.3	CONFIRMED SHORT TERM (8 HRS) ON EM, PF & F1 COOLER AND B/B COLD STAGE TESTS; LONG TERM (2 YRS) TEMPERATURE DRIFT UNCONFIRMED

RADIATIVE COOLER PERFORMANCE (CONT)

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PARAMETER	REQUIREMENT	GSFC SPEC	TEST PERFORMANCE
ANTICONTAMINATION PROVISIONS	COMMANDABLE OUTGAS HEATERS FOR USE WITH DOOR DEPLOYED	3.3.3.4	CONFIRMED BY EM/PF F1 COOLER TV TEST
	TEST FOR DETECTOR RESPONSIVITY DEGRADATION DUE TO CONTAMINATION	GSFC REQUEST	EM COOLER TV TEST CONFIRMS NO DEGRADATION AFTER 200 HR OF OPERATION
BENCH TEST CAPABILITY	OPERATION OF INSTRUMENT AT AMBIENT CONDITIONS USING BENCH TEST COOLER TO PROVIDE ORBIT OPERATIONAL TEMPERATURES FOR ALL COOLED DETECTORS	3.3.3.5	CONFIRMED BY BENCH COOLER TESTS WITH EM, PF AND F1 RADIATIVE COOLER

RADIATIVE COOLER DOOR/SHROUD

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FUNCTION:

- PROTECT GRAPHITE STRUCTURE FROM CONTAMINATION
- SUPPORT RADIATIVE COOLER DOOR
- SUPPORT THERMAL BLANKETS
- ON / OFF CAPABILITY FOR RADIATIVE COOLER
- SHIELDS COOLER FROM EARTH ALBEDO

DESIGN

- VENTED AT HONEYCOMB PANELS
- ELECTROMAGNETIC LATCHES SECURE DOOR DURING LAUNCH
- DOOR OPERATED BY BRUSHLESS DC MOTOR WITH PLANETARY GEAR REDUCTION AND INTERNAL BRAKING
- SPRING-LOADED LINK WITH FUSIBLE SLUG OPERATES DOOR IF MOTOR FAILS

CHANGES SINCE PFR

- SPOT BOND ATTACHING HARDWARE TO INSURE LOCKING
- REDUNDANT CLOSED POSITION SWITCH ADDED

RADIATIVE COOLER DOOR/SHROUD (CONT.)

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ANALYSIS / TEST

DESIGN VERIFIED BY PF QUALIFICATION TEST

EM FAILSAFE LINK SUCCESSFULLY FIRED

MOTOR AND LINK OPERATED SUCCESSFULLY DURING UNIT LEVEL QUAL TESTING (PACR 79 / 04)

RELIABILITY VERIFIED BY F1 TESTING (STR F013, STR F014)

STATUS

F1 SHROUD ASSEMBLY COMPLETED

F1 COOLER DOOR ASSEMBLY COMPLETED

MODEL PERFORMANCE DIFFERENCES

NONE

RADIATIVE COOLER DOOR/SHROUD TEST SEQUENCE

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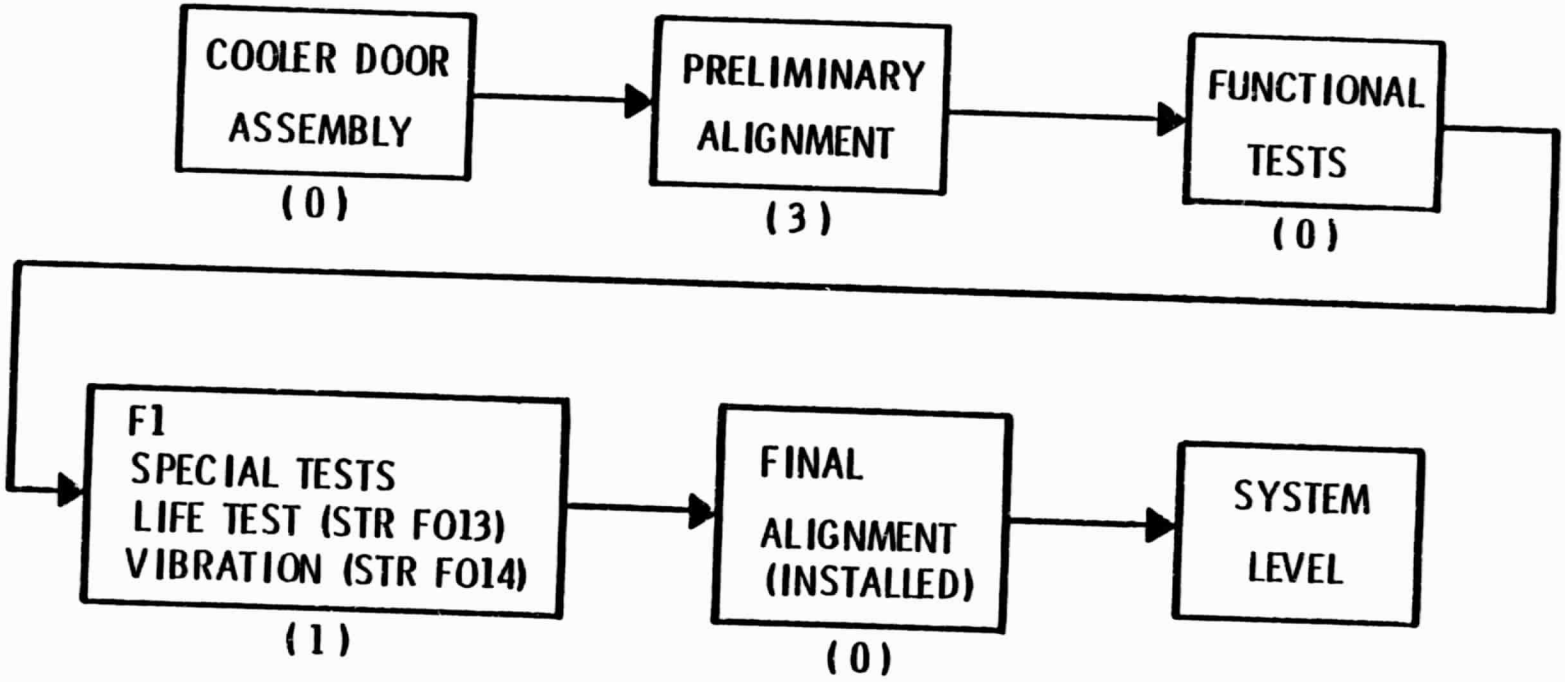

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DEVIATION/WAIVER

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NUMBER	MODEL	SUBJECT	JUSTIFICATION
SBW 032	F1	RADIATIVE COOLER NICKEL UNDER-PLATING	ONLY APPROVED VENDOR THAT CAN MEET SCHEDULE. FIT TOLERANCES ARE ACCEPTABLE WITH ADDED PLATING.
W 95	F1	PRIMARY MIRROR STRUCTURAL WAIVER	ENGINEERING EVALUATION FOR REUSE FOLLOWING PENALTY AND PERFORMANCE TESTS.
W 129	F1	TELESCOPE ASSEMBLY BLACK PAINT FLAKING	INVAR AND ALUMINUM SURFACES IN LOW HUMIDITY ENVIRONMENT WILL NOT CORRODE. REPAINTING WOULD BE IMPRACTICAL.
D 134	F1	REDUNDANT SHUTTER CABLE SUPPORT PIN	MACHINE PIN RATHER THAN HOLE TO PREVENT CONTAMINATING SHUTTER ASSEMBLY.
W 136	F1	LOW VALUE FOR TELESCOPE MTF	WILL STILL MEET SYSTEM REQUIRE-MENTS AS IS. REWORK WOULD INVOLVE CATASTROPHIC SCHEDULE AND COST IMPACT.
W 137	F1	REFLECTANCE OF TELESCOPE OPTICS	ANALYSIS INDICATES NO EVIDENCE OF SYSTEM PERFORMANCE DEGRADATION BELOW SYSTEM SPECIFICATION, DESPITE OUT-OF-SPEC CONDITION AT SUB-ASSY LEVEL.
D 138	F1	DOCUMENTATION DEFICIENCY OF TELESCOPE THERMISTORS	SUFFICIENT DOCUMENTATION IS AVAILABLE TO INSURE FLIGHT QUALITY OF ASSEMBLED THERMISTORS.

DEVIATION/WAIVER

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HUGHES AIRCRAFT COMPANY

NUMBER	MODEL	SUBJECT	JUSTIFICATION
W 139	F1	SOLITHANE CONFORMAL COATING	REMOVAL OF SOLITHANE FROM COATED COMPONENTS (TERMINALS) WOULD ENTAIL RISK OF DAMAGE.
W 140	F1	MISSING PLANNING FOR THERMISTOR BLOCK ASSEMBLY	ELECTRICAL CHECKS VERIFY THE CORRECT RESISTANCE AS INSTALLED.
W 141	F1	MISSING PLANNING FOR SCREW TRIM OPERATION	ASSEMBLY WOULD NOT HAVE PROCEEDED UNTIL SCREW LENGTHS WERE CORRECTED.
W 143	F1	MISSING PLANNING FOR BAFFLE ASSEMBLY E08842	HARDWARE HAS BEEN BUILT TO THE FULL EXTEND OF E08842. RECORDS SHOW THAT THE BAFFLE ASSEMBLY IS SUITABLE FOR FLIGHT USE.
W 144	F1	RADIATIVE COOLER TEST PLAN	ERRONEOUS INTERPRETATION OF E04152A.
W 147	F1	RADIATIVE COOLER TEST PLAN	SHORTENED HIGH VACUUM BAKEOUT TIME TO REDUCE COST.
W 149	F1	RADIATIVE COOLER CIRCUIT DIAGRAM	REDUNDANT LEAD MAINTAINS CIRCUIT OPERATIONAL.
W 151	F1	PERMISSION TO SHORTEN TEMPERATURE CONTROL TESTS OF RADIATIVE COOLER	SCHEDULE RELIEF IN FAVOR OF HIGHER PRIORITY TEST ITEMS.

SYSTEM TEST

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FLIGHT MODEL TEST SEQUENCE

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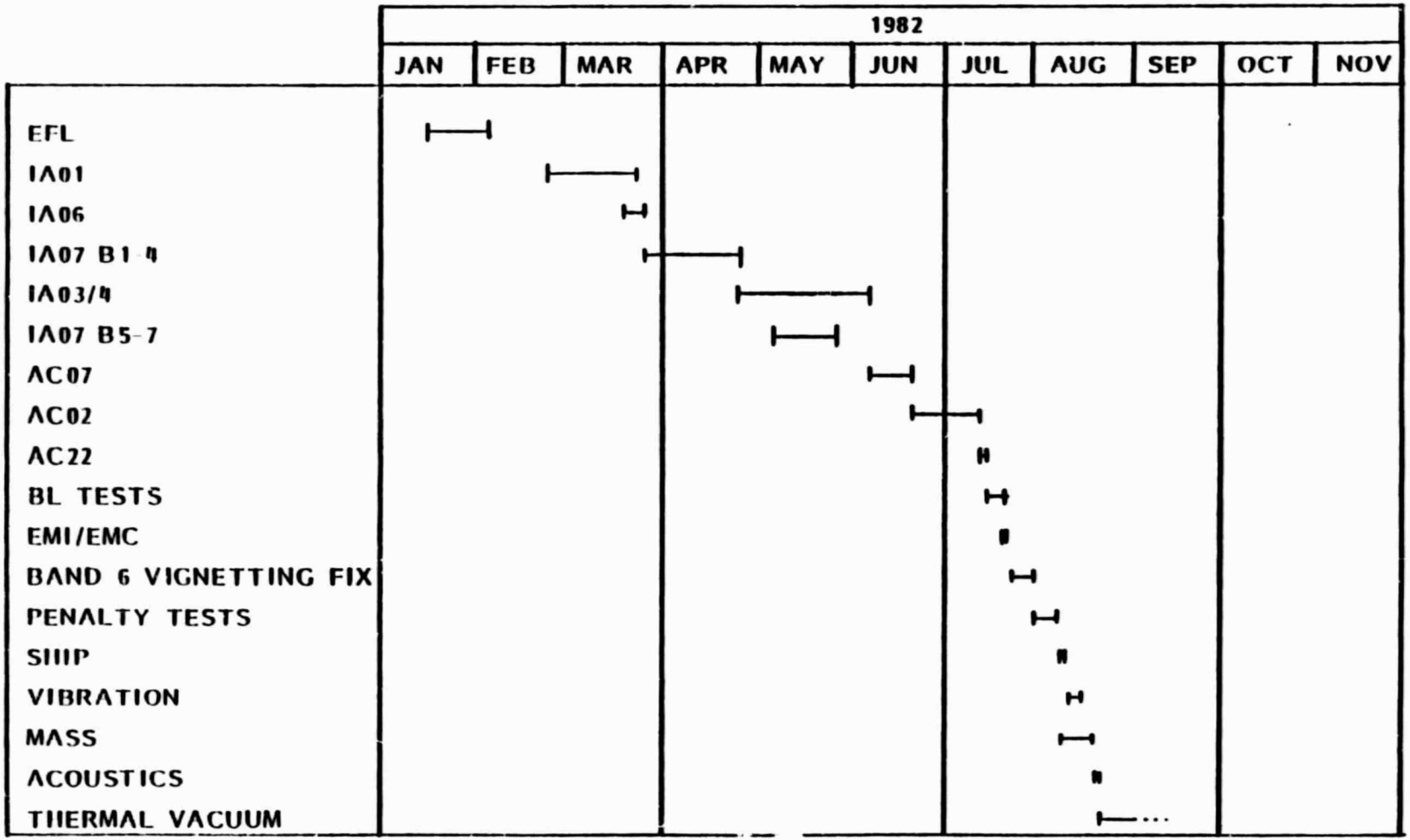

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IA01 TEST DESCRIPTION

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OBJECTIVES

- BANDS 1 THROUGH 4, COARSE FOCUS, FINE FOCUS, INTERCONNECT VERIFICATION, AND VIGNETTING.

TEST FLOW

- USING KINETIC KNIFE EDGE TECHNIQUE FOR MEASURING MTF, CONDUCT MTF SURVEY OF IMAGE FROM -0.030 IN. TO +0.030 IN. FOCUS IN ALONG-TRACK AND CROSSTRACK DIRECTION OF COMBINED SCAN MIRROR AND TELESCOPE ASSEMBLY.
- SELECT BEST FOCUS FROM MTF DATA, INSTALL CORRECT SHIM AND VERIFY FOCUS BY REPEATING SURVEY
- USING IFOV INTERCONNECT MASK, SELECTIVELY UNCOVER DETECTORS AND MONITOR CHANNEL OUTPUT

DATA OUTPUT

- MTF PLOTS, FOCUS-VS-PEAK MTF, MANUAL PLOTS OF BAFFLE CLEARANCE

RESULTS

- SHIM AND FPA LOCATION ACCEPTABLE
- MTF (CT) RANGE FROM 0.45 TO 0.55, (AT) 0.42 TO 0.54
- NO SIGNIFICANT TILT TO THE FPA

IA03R TEST DESCRIPTION

SBRC

A SUBSIDIARY OF ROCKWELL INTERNATIONAL CORPORATION

OBJECTIVE

DETERMINE IMAGE QUALITY AT COLD FOCAL PLANE, AND DETERMINE BEST SHIM THICKNESS FOR OPTIMUM FOCUS

TEST FLOW

WITH TM LOOKING AT COLLIMATOR, CONDUCT AXIAL MTF SURVEY BY STEPPING KINETIC KNIFE EDGE FROM – 0.60 TO -0.25 IN. IN Z DIRECTION. PLOT MTF PEAK AS FUNCTION OF Z MOTION FOR ALONG AND CROSSTRACK. FROM PLOTS DETERMINE OPTIMUM SHIM THICKNESS. AS IN IA01, MANUALLY SURVEY AFT OPTICS BAFFLES, LOCATE CENTERS

DATA OUTPUT

MTF PLOTS AS FUNCTION OF AXIAL DISPLACEMENT, SHIM THICKNESS, LIMITING RAY CLEARANCE WITH BAFFLES

IA04 TEST DESCRIPTION

SBRC
A SUBSIDIARY OF
HUGHES AIRCRAFT COMPANY

TEST OBJECTIVE

ESTABLISH FINE FOCUS OF CFPA, ROTATIONALLY ALIGN CFPA TO PFPA, TRANSLATE CFPA TO PROVIDE BAND-TO-BAND REGISTRATION WITH PFPA

TEST FLOW

CONDUCT AXIAL MTF SURVEY OF IMAGE PLANE, MOVE RELAY SPHERICAL MIRROR BY USING INCHWORMS TO CORRECT FOCUS. USING IA RETICLE AND KNIFE EDGE RESPONSES, COMPUTE ROTATION OF CFPA RELATIVE TO PFPA (< 5MR). ADJUST CFPA WITH TOOL. USING IA RETICLE AND INCHWORMS TRANSLATE CFPA FOR BEST BBR FIT TO PFPA. PERFORM CFPA INTERCONNECT VERIFICATION (SIMILAR TO TEST PERFORMED IN IA01).

DATA OUTPUT

MTF AS FUNCTION OF AXIAL DISPLACEMENT, DETECTOR REGISTRATION TO PFPA

RESULTS

BAND-TO-BAND REGISTRATION IS WITHIN SPECIFICATION

IA06 TEST DESCRIPTION

SBRC
A SUBSIDIARY OF
HUGHES AIRCRAFT COMPANY

OBJECTIVE

VERIFY ROTATIONAL ALIGNMENT OF TELESCOPE HOUSING IN MAINFRAME SUCH THAT SCAN MIRROR PIVOT AXIS IS ORTHOGONAL TO DETECTOR ALONG-SCAN BASELINE. REESTABLISH BASELINE MTF VALUES IF HOUSING IS ROTATED. VERIFY CENTRATION OF SCAN MIRROR.

TEST FLOW

ROTATIONALLY ALIGN EDGE OF COLLIMATOR MOUNTED RETICLE TO BE PARALLEL TO Y-AXIS. ROTATE TM TO ALIGN SMA PIVOT AXIS ORTHOGONAL TO RETICLE EDGE BY MONITORING DETECTOR MODULATION IN BANDS 1 AND 4. ROTATE HOUSING AS NEEDED TO GET ZERO OUTPUT. TEST SLC ALIGNMENT, BASELINE MTF FOLLOWING ROTATION.

DATA OUTPUT

RELATIVE ROTATIONAL ALIGNMENTS OF SMA PIVOT AXIS, SLC PIVOT AXIS, DETECTOR ARRAY. BASELINE MTF VALUES ARE ESTABLISHED.

RESULTS

SHIM DETERMINED IN IA01 FOUND TO BE APPROPRIATE. SMA TO PFPA ALIGNMENT ERROR = -0.02 MR. SPEC = 10.5 MRL. SCAN MIRROR CENTRATION WITHIN TOLERANCES.

AC-07R TEST DESCRIPTION

SBRC
A SUBSIDIARY OF
HUGHES AIRCRAFT COMPANY

OBJECTIVES

DETERMINE INSTANTANTANEOUS FIELD OF VIEW (IFOV) OF REPRESENTATIVE DETECTORS IN EACH BAND BY MAPPING RESPONSE OUT TO ± 2 IFOVS

TEST FLOW

USING 109.3 IN. FOCAL LENGTH COLLIMATOR AND TM WITH LOCKED SCAN MIRROR, START AT BAND 4 AND FOR EACH DETECTOR SCAN WIDE SLIT FROM -12.25 IFOV TO -2.25 IFOV. SCAN NARROW (0.1 IFOV) FROM -3.75 TO +3.75 IFOV IN 20 STEPS. CONTINUE SCAN OF WIDE SLIT FROM 2.25 IFOV TO +12.25 IFOV. ROTATE SLIT PATTERN 90°, SCAN VERTICALLY IN LIKE FASHION. AT EACH POSITION COLLECT DATA. FIND PEAK SIGNAL IN X, Y SCANS. NORMALIZE DATA, COMPUTE 50% RESPONSE POINTS, FIND BOUNDARIES OF IFOV.

DATA OUTPUT

DETECTOR SIZE, LOCATION, PRINTED IFOV DATA CONVERTED TO RADIAN MEASURE RELATIVE TO OPTICAL AXIS, PLOTTED

RESULTS

TEST DATA INDICATES IFOV SIZE OF BAND 1-5 AND 7 DETECTORS IS SLIGHTLY LARGER THAN SPECIFICATION ALLOWS.

IA07 TEST SUMMARY

SBRC
A SUBSIDIARY OF
HUGHES AIRCRAFT COMPANY

OBJECTIVE

CHECK ELECTRONICS MODULE INTEGRATION, POWER, COMMANDS, TELEMETRY, REDUNDANCY, SYSTEM TIMING, VIDEO CHANNEL NOISE, VERIFY INTERCONNECTION

TEST FLOW

PERFORM PRELIMINARY WIRING, POWER AND GROUND CHECK; VERIFY TELEMETRY SCALING, CHECK FIVE HEATERS. CHECK BLACKBODY, SMA CONTROL, DC RESTORE, FUSIBLE LINK DRIVE, COOLER DOOR, INCHWORM DRIVE. AUTOMATICALLY SEQUENCE CALIBRATION LAMPS THROUGH 8 RADIANCE STEPS, VERIFY CALIBRATION SHUTTER CONTROL. CONDUCT SLC TEST, VERIFY BAND TELEMETRY, CONDUCT POWER PROFILE, CONDUCT IFOV INTERCONNECT THROUGH MULTIPLEXER OUTPUT.

DATA OUTPUT

TABULAR VERIFICATION OF COMMANDS, TELEMETRY, ETC.

RESULTS

ELECTRONICS MODULE INTEGRATION SUCCESSFULLY COMPLETED.

AC02R TEST DESCRIPTION

SBRC
A SUBSIDIARY OF [illegible] AIRCRAFT COMPANY

OBJECTIVES

- CALCULATE GAIN TRIM RESISTORS FOR EACH BAND
- MEASURE END TO END RADIOMETRIC TRANSFER FUNCTION TO BETTER THAN 10% FULL SCALE
- MEASURE RELATIVE TRANSFER FUNCTION, DETECTOR-TO-DETECTOR WITHIN 1/4% RMS NOISE
- MEASURES RELATIVE RADIOMETRIC ACCURACY BETWEEN BANDS WITHIN 2%
- CALIBRATE INTERNAL CALIBRATOR
- DETERMINE GAIN AND OFFSET, S/N OF EACH CHANNEL

TEST FLOW

- ALIGN TM APERTURE WITH 48 IN. SPHERICAL INTEGRATING SOURCE (SIS)
- RECORD ZERO RADIANCE LEVEL, MAX RADIANCE LEVEL IN EACH BAND
- CALCULATE TRIM RESISTORS, INSTALL NEW RESISTORS IN TM REPEAT TEST
- TURN ON 48 IN. SIS TO HIGHEST LEVEL, DECREMENT RADIANCE 20 STEPS - RECORD DATA (95K CFPA)
- CHANGE CFPA TEMPERATURE TO 105K. REPEAT 20 RADIANCE STEPS
- TURN ON INTERNAL CALIBRATOR, DECREMENT 8 RADIANCE LEVELS, RECORD DATA OUTPUT
- COMPUTE GAINS, OFFSETS, S/N

AC22R TEST DESCRIPTION

SBRC
A SUBSIDIARY OF
HUGHES AIRCRAFT COMPANY

OBJECTIVE

VERIFY THAT ALL DETECTORS IN EACH BAND 1-5 AND 7 HAVE THE SAME SPECTRAL RESPONSE

SPECIFICATION REQUIREMENT

FOR SCENES OF BOTH "FLAT" AND "SLOPED" SPECTRAL RADIANCE, THE DIFFERENCE BETWEEN BAND MAX AND MIN VALUES OF EFFECTIVE RADIANCE COMPUTED FROM MEASURED TM RESPONSE MUST BE $\leq 0.5\%$ OF THE SPECIFIED MINIMUM SATURATION LEVEL RADIANCE (MSL)

TEST IMPLEMENTATION

1. 48 INCH SPHERICAL INTEGRATING SOURCE (SIS) USED TO PRODUCE A SCENE OF "FLAT" SPECTRAL RADIANCE
2. COLLIMATOR NO. 3 SIS AND APPROPRIATE COLOR GLASS FILTERS USED TO PRODUCE A SCENE OF "SLOPED" SPECTRAL RADIANCE
3. DATA COLLECTED FROM EACH SCENE, EFFECTIVE RADIANCE COMPUTED, AND VALUES IN EACH BAND SUBJECTED TO SPECIFICATION REQUIREMENT

BL-07R TEST DESCRIPTION

SBRC
A SUBSIDIARY OF
HUGHES AIRCRAFT COMPANY

OBJECTIVES

TRANSFERS CALIBRATION OF 48 IN. INTEGRATING SPHERE TO THE TM CALIBRATOR USING THEMATIC MAPPER AS CALIBRATION TRANSFER DEVICE.

TEST FLOW

COLLECT DATA FROM MTF SIS AT EACH OF 8 RADIANCE LEVELS ESTABLISHED BY NEUTRAL DENSITY FILTER WHEEL. REPEAT FOR 3 FPA TEMPERATURES 1°C APART. COLLECT OPAQUE AND CLEAR DATA. REPEAT ENTIRE SEQUENCE WITH STABLE AMBIENT FPA TEMPERATURE. USING AC02 GAINS AND OFFSETS, COMPUTE EFFECTIVE RADIANCE OF EACH RADIANCE LEVEL. DETERMINE SHADING FACTORS.

DATA OUTPUT

EFFECTIVE RADIANCE AT 8 DIFFERENT LEVELS 2 DIFFERENT FPA TEMPERATURES; SHADING FACTORS; OBC CALIBRATION DATA

RESULTS

CALIBRATION TRANSFERRED FROM 48 IN. INTEGRATING SPHERE TO THE CALIBRATOR.

BL 16/17R TEST DESCRIPTION

SBRC

A SUBSIDIARY OF HUGHES AIRCRAFT COMPANY

OBJECTIVES

MEASURE DYNAMIC SQUARE WAVE RESPONSE OF TM

TEST FLOW

FOR BANDS 1 TO 5 AND 7, CALIBRATOR PHASED KNIFE EDGE RETICLE SCANS ACROSS TM DETECTORS BY SMA. RESULTING DATA STREAM IS SORTED AND CONVERTED TO KNIFE EDGE RESPONSE CURVE. SPATIAL FREQUENCY BAR PATTERNS ARE ANALYTICALLY SUPERIMPOSED ON THE KNIFE EDGE RESPONSE CURVE AND SHIFTED IN 0.1 IFOV INCREMENTS. MAX AND MIN VALUES OVER ONE BAR CYCLE ARE NOTED. THEN

$$SWR = \frac{MAX-MIN}{MAX+MIN}$$

BAND 6 PROCESSED IDENTICALLY, EXCEPT THAT RETICLE SHIFTED 0.1 IFOV AFTER FIRST DATA SET TO PROVIDE MORE DATA POINTS OVER LARGER IFOV

DATA OUTPUT

SQUARE WAVE RESPONSE FOR ALL BANDS

BL19/20 TEST DESCRIPTION

SBRC

A SUBSIDIARY OF HUGHES AIRCRAFT COMPANY

OBJECTIVE

- PROVIDE SELF INDUCED VIBRATION FREQUENCY AND AMPLITUDE INFORMATION
- DETERMINE BAND-TO-BAND REGISTRATION, GEOMETRIC ACCURACY (SCAN PROFILE)

TEST FLOW

- USING BBR/GA RETICLE (73118) IN CALIBRATOR, COLLECT DATA AT EACH OF 31 CALIBRATOR ROTARY TABLE POSITIONS
- USING POSITION CODING DERIVED FROM RETICLE, ANALYTICALLY ASSEMBLE RETICLE PATTERNS IN SEQUENCE ACROSS FULL SCAN
- DETERMINE CROSS SCAN SIGNAL CALIBRATION USING RETICLE 72717
- USING INFORMATION FROM BOTH RETICLES TRACE PATH OF INDIVIDUAL DETECTORS ACROSS 31 RETICLE PATTERNS
- DETERMINE SCAN PROFILE POLYNOMIAL COEFFICIENTS
- DETERMINE GEOMETRIC ACCURACY, BBR
- EXAMINE FREQUENCY CONTENT FOR SIV
- NOTE EFFECT OF SLC ON VS OFF

DATA OUTPUT

SCAN LINEARITY, SIV FREQUENCYS,SLC PROFILE, SCAN PROFILE, BAND-TO-BAND REGISTRATION.

BL1OR TEST DESCRIPTION

SBRC

OBJECTIVE

- MEASURES END-TO-END TRANSFER FUNCTION OF EACH BAND & CHANNEL TO AN ABSOLUTE ACCURACY BETTER THAN 10%
- MEASURES RELATIVE TRANSFER FUNCTION < 1/4% OF RMS NOISE LEVEL
- ESTABLISHES GAINS AND OFFSETS; CALIBRATES INTERNAL CALIBRATOR, AND MEASURES SIGNAL DRIFT

TEST FLOW

- THERMALLY CONDITION SENSOR BY CONDUCTING THREE OPERATIONAL PROFILES (100 MINUTE ORBIT) AT 10% DUTY CYCLE; COLLECT SIGNAL DRIFT DATA, AND CONDUCT TWO MORE OPERATIONAL PROFILES
- COLLECT DATA WITH BLACKBODY AT FIVE TEMP AND COLD FOCAL PLANE AT THREE TEMP TO ESTABLISH GAIN, LINEARITY
- CONDITION SENSOR WITH THREE MORE OPERATIONAL PROFILES, AND COLLECT SECOND SIGNAL DRIFT DATA
- COLLECT SLC PROFILE DATA (ON VS OFF)
- FINISH 24 HR SIGNAL DRIFT TIME WITH 30% DUTY CYCLE OPERATIONAL PROFILES
- COLLECT LAST SIGNAL DRIFT DATA

DATA OUTPUT

- SLC TEMP PROFILE, OPERATIONAL PROFILES, GAIN LINEARITY OUTPUTS, SIGNAL DRIFT, NETD FOR EACH DETECTOR, AND SHADING FACTORS

BL-12 TEST DESCRIPTION

SBRC
A SUBSIDIARY OF
HUGHES AIRCRAFT COMPANY

OBJECTIVE

- EVALUATE THEMATIC MAPPER COHERENT NOISE SIGNATURE OVER LOWER 64 PCM LEVELS FOR BANDS 1 TO 5 AND 7
- EVALUATE BAND 6 AT FOUR DISCRETE PCM LEVELS
- PROVIDE VISUAL DISPLAY OUTPUT AND POWER SPECTRAL DENSITY VALUES

TEST FLOW

- ALIGN CALIBRATOR TO THEMATIC MAPPER, TURN ON FLOOD LAMP, COLLECT DATA
- REMOVE FLOOD LAMP; TURN ON BLACKBODY; SET AT LOWEST TEMP; COLLECT DATA
- ADJUST TEMP TO FOUR DIFFERENT LEVELS; COLLECT DATA
- TURN OFF CALIBRATOR, THEMATIC MAPPER
- SELECT DATA REDUCTION OPTION. IF PHOTOGRAPHIC OUTPUT IS DESIRED, OUTPUT DATA TO LASER PHOTOWRITER. IF PSD IS DESIRED, PRETREAT DATA BY WEIGHTING, ADJUST ARRAY SIZE, CALCULATE FAST FOURIER TRANSFORM, CALCULATE PSD, SMOOTH OUTPUT, AND PLOT

DATA OUTPUT

- PHOTO IMAGES OF RADIANCE GRADIENT, PSD PLOTS

RESULTS

- DATA COLLECTED
- VISUAL IMAGES OBTAINED FROM COMTAL RECORDER

SYSTEM READINESS TEST (SRT)

SBRC

A SUBSIDIARY OF RAYTHEON AIRCRAFT COMPANY

OBJECTIVE

- TO DETERMINE OVERALL SYSTEMS READINESS OF THE THERMATIC MAPPER
- TEST WILL BE IMPLEMENTED AT ANY TIME DURING THE TEST PROGRAM TO VERIFY THAT NO GROSS MALFUNCTIONS HAVE OCCURRED.

TEST FLOW

- FUNCTIONAL OPERABILITY
  - USES COMMAND FILE TO AUTOMATICALLY COMMAND SYSTEM TO VERIFY RESPONSE THROUGH TELEMETRY
  - PERFORMED IN PRIMARY AND REDUNDANT MODES.
- RADIOMETRIC PERFORMANCE
  - MONITORS RADIOMETRIC PERFORMANCE AND LONG TERM STABILITY, WITH 4 OPTIONS
    - BAND 1 - 4, 5 & 7 USING INTERNAL CALIBRATION LAMPS
    - BAND 1 - 4, 5 & 7 USING EXTERNAL TM CALIBRATOR SPHERICAL INTEGRATOR SOURCE
    - BAND 6 USING INTERNAL BLACKBODY
    - BAND 6 USING EXTERNAL TM CALIBRATOR BLACKBODY
- SCAN MIRROR ASSEMBLY LINE LENGTH
  - USED TO VERIFY STABILITY OF SCAN PROFILE
  - DATA COLLECTED FOR 100 SCANS
  - SCAN MIRROR ELECTRONICS CHECKED CONCURRENTLY

FLIGHT MODEL TEST PLAN

SBRC

A SUBSIDIARY OF HUGHES AIRCRAFT COMPANY

TEST NUMBER	TEST NAME
IA01	PRIME FOCAL PLANE COARSE AND FINE FOCUS
IA06	SCAN MIRROR TO RADIOMETER ALIGNMENT
IA03	COOLED FOCAL PLANE COARSE FOCUS
IA04	COOLED FOCAL PLANE FINE FOCUS & BAND-TO-BAND REGISTRATION
AC07	SPATIAL COVERAGE
IA07	ELECTRONICS MODULE INTEGRATION
AC02	GAIN SETTING, RADIOMETRIC CALIB, & OBC CALIB; BANDS 1-5 & 7
AC22	SPECTRAL MATCHING
BL07	RADIOMETRIC CALIBRATION OF TM CALIBRATOR & SPECTRAL MATCHING
BL16	SQUARE WAVE RESPONSE BANDS 1-5 & 7
BL17	SQUARE WAVE RESPONSE BAND 6
BL10	RADIOMETRIC CALIBRATION BAND 6
BL12	COHERENT NOISE
BL 19/20	GEOMETRIC ACCURACY/BAND-TO-BAND REGISTRATION
MASS PROPERTIES	MASS PROPERTIES (WEIGHT, CG, MOMENTS OF INERTIA)
SINE VIBRATION	SINE VIBRATION TESTING - QUALIFICATION
ACOUSTIC NOISE	ACOUSTIC NOISE TESTING - QUALIFICATION
THERMAL VACUUM	VACUUM PERFORMANCE TESTING

F-1 THEMATIC MAPPER THERMAL PROFILE

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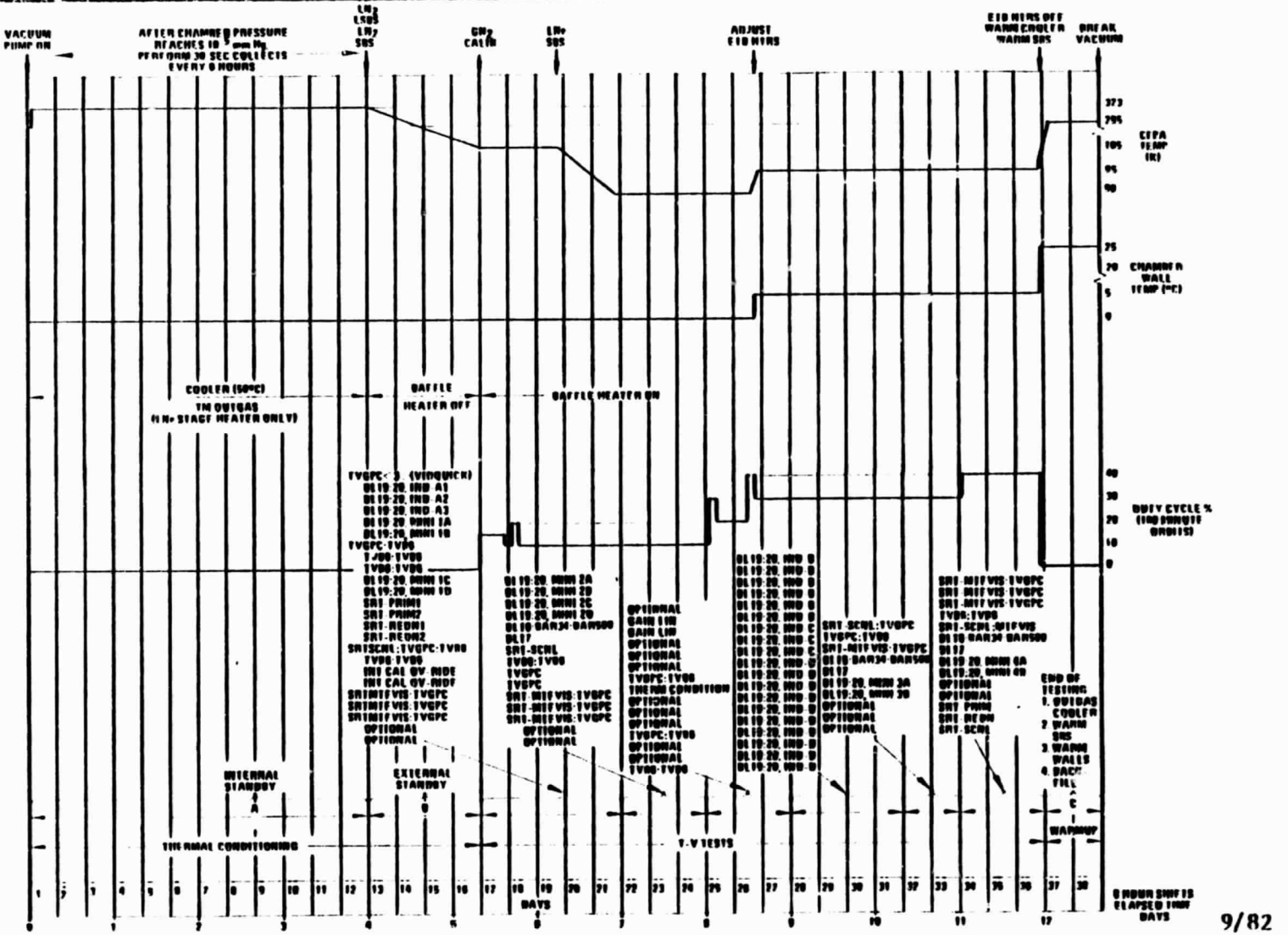
HUGHES AIRCRAFT COMPANY



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FLIGHT MODEL ACOUSTICAL TESTING

SBRC

ACOUSTICS DURATION: 1.0 MINUTE		
OCT BAND CENTER FREQUENCY HZ	PF OCT BAND SPL, DB: RE20UN/M2	FL OCT BAND SPL, DB: RE20UN/M2
31.5	131*	125*
63	137*	128*
125	141	134*
250	143	137
500	144	141
1000	140	134
2000	137	131
4000	133	127
8000	130	124
Overall	149	144

*GOALS SUBJECT TO FACILITY LIMITATIONS

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FLIGHT MODEL
VIBRATION TESTING

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A SUBSIDIARY OF
HUGHES AIRCRAFT COMPANY

REF: 1. TP 32015-609 VIBRATION TEST SPECIFICATION.

2. TM WAIVER W-171 (CHANGED THRUST AXIS LEVELS).

VIBRATION			
SINUSOIDAL REQUIREMENTS			
AXIS	FREQ, Hz	FL LEVEL	SWEEP RATE, OCT/MIN
THRUST	5 TO 11.1 11.1 TO 50 50 TO 100	0.64 IN DA ±4.0 g ±2.4 g	4.0
LATERAL (Z–Z Y–Y)	5 TO 9.3 9.3 TO 35 35 TO 100	0.64 IN DA ±2.8 g ±1.2 g	4.0

FLIGHT MODEL VIBRATION AND ACOUSTIC TEST RESULTS

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- HIGHEST RESPONSE 35G (3a) AT COOLER DOOR/COOLER SHROUD DURING ACOUSTIC TEST. (PREDICTED 50G)
- POSITIVE MARGINS IN ALL AREAS
- MULTIPLEXER AND POWER SUPPLY RESPONSE LEVELS AS ANTICIPATED.
- NO STRUCTURAL RESONANCES BELOW 66Hz (ROCKING MODE OF TM ON FEET IN Z AXIS).

FLIGHT MODEL ELECTROMAGNETIC COMPATIBILITY TESTING

SBRC
A SUBSIDIARY OF
HUGHES AIRCRAFT COMPANY

TEST OBJECTIVE

TO INSURE THAT TM WILL NOT CAUSE OR BE SUSCEPTABLE TO ELECTRO-MAGNETIC INTERFERENCE WHEN INTEGRATED WITH OTHER COMPONENTS. TEST CONDUCTED WITH TM IN PICTURE MODE.

TEST CONFIGURATION

CE01, CE03 : 10 μf FEEDTHROUGH CAPACITOR IN SERIES WITH PRIMARY POWER AND RETURN LEADS TO EXTERNAL EMI FILTER J-1 CONNECTOR. GROUND LEG OF CAPACITOR CLAMPED TO TM TM MAIN FRAME.

CS01 : ISOLATION TRANSFORMER WIRED IN SERIES WITH EACH POWER LEAD TO EXTERNAL EMI FILTER. 26V BUS VOLTAGE.

CS02 : CAPACITIVE INJECTION NETWORK WIRED IN PARALLEL WITH EACH POWER LEAD TO EXTERNAL EMI FILTER. 26V BUS VOLTAGE. INJECTION POINT WITHIN 5 CM ELECTRICAL LENGTH OF INPUT POWER CONNECTOR TO MINIMIZE EMI SIGNAL INSERTION LOSS.

TEST OUTPUT

BROADBAND AND NARROWBAND PLOTS, TABULATED DATA

FLIGHT MODEL EMI TESTS

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CONDUCTED

- **SUSCEPTIBILITY** — POWER LINE FILTERS REQUIRED (CS01, CS02)
- **EMISSIONS** — SPECIFICATION MET (CE01, CE03)

TESTING PER MIL-STD 461A/HS 236-8092

CONDUCTED SUSCEPTIBILITY
CS01/CS02

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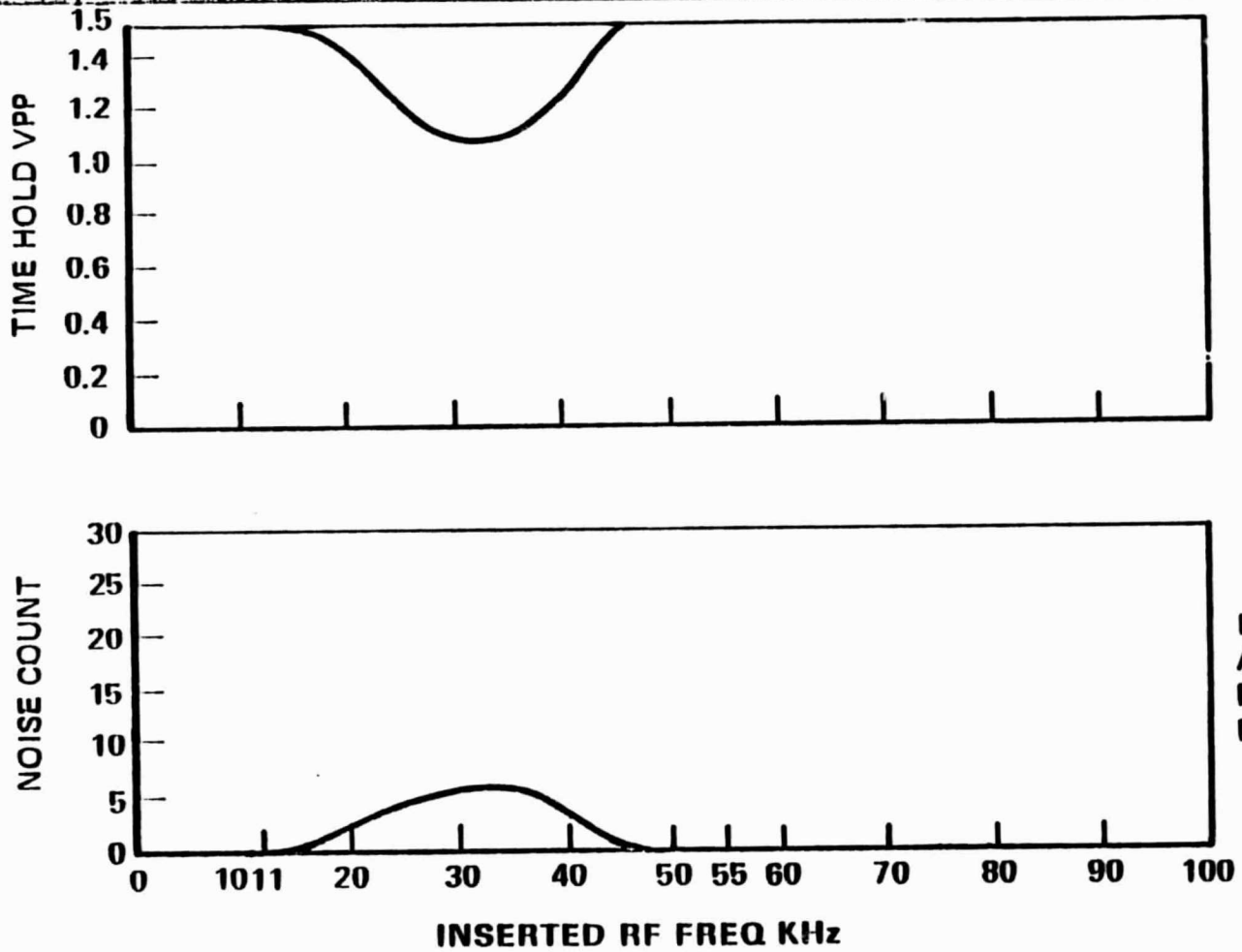

FILTER IN BOTH 28 V
AND RETURN LINES
RF INSERTED IN 28 V LINE
KEPCO AT 28 V AND 25 V

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21170-115

ALL MODELS
WEIGHT (Kg) (3.2.1)

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	WEIGHT (Kg)
ENGINEERING MODEL	244.3
PROTOFLIGHT MODEL	244.4
FLIGHT MODEL	247.0

SYSTEM PERFORMANCE

21170-103

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TECHNICAL PERFORMANCE REVIEW

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SPATIAL COVERAGE	J. ENGEL
SPECTRAL COVERAGE	J. ENGEL
SQUARE WAVE RESPONSE	J. ENGEL
THERMAL PERFORMANCE	T. CAFFERTY
COMMAND & TELEMETRY STATUS	S. OXLEY
POWER CONSUMPTION	S. OXLEY
SCAN REPEATABILITY	S. OXLEY
SCAN PROFILE	D. BRANDSHAFT
BAND-TO-BAND REGISTRATION	D. BRANDSHAFT
RADIOMETRIC PERFORMANCE	
BAND 6	J. LANSING
BANDS 1-5 & 7	J. ENGEL
COHERENT NOISE	J. ENGEL
SUMMARY	J. ENGEL

FLIGHT MODEL
SPATIAL COVERAGE (3.2.3)

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PRIME FOCAL PLANE

BAND	CHANNEL	LINE SPREAD FUNCTION WIDTH (μrad)		
		TRACK	SCAN	SPECIFIED
1	1	44.8	46.3	≤ 43.2
	2	45.1	45.3	
	15	43.4	46.0	
	16	43.2	44.3	
2	1	45.9	44.5	
	2	45.6	44.6	
	15	44.1	44.7	
	16	42.9	44.7	
3	1	44.2	44.7	
	2	43.3	43.6	
	15	44.1	43.6	
	16	42.7	43.7	
4	1	45.7	44.4	
	2	43.8	45.9	
	15	44.3	45.3	
	16	42.9	44.3	

FLIGHT MODEL
SPATIAL COVERAGE (3.2.3)

SBRC
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HUGHES AIRCRAFT COMPANY

COOLED FOCAL PLANE

BAND	CHANNEL	LINE SPREAD FUNCTION WIDTH (μrad) TRACK	SCAN	SPECIFIED
5	1	51.4	44.8	< 46.35
5	2	50.5	44.5	
5	15	51.0	44.7	
5	16	50.0	44.5	
7	1	46.7	45.8	
7	2	46.4	45.4	
7	15	46.8	45.4	
7	16	46.9	45.0	

NOTE: BAND 6 WAS NOT REMEASURED AT THE SYSTEM LEVEL DUE TO THE DIFFICULTY OF THE MEASUREMENT AND THE FACT THAT THE DETECTOR SIZE AND EFL WERE KNOWN AND SQUARE WAVE RESPONSE EXCEEDED THE SPECIFICATION WITH SIGNIFICANT MARGIN.

SPATIAL COVERAGE

SBRC
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HUGHES AIRCRAFT COMPANY

- THE TEST DATA INDICATES THAT THE IFOV SIZE OF THE BAND 1 - 5 AND 7 DETECTORS IS SLIGHTLY LARGER THAN THE SPECIFICATION ALLOWS.
- SQUARE WAVE RESPONSE EXCEEDS SPECIFICATION.
- WAIVER HAS BEEN SUBMITTED.
- PERFORMANCE IS VERY SIMILAR TO THAT OF THE PROTOFLIGHT

FLIGHT MODEL
SPECTRAL COVERAGE PERFORMANCE
(3.2.8)

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BAND	REQUIREMENT 50% RESPONSE BAND EDGE, μM		PERFORMANCE 50% RESPONSE BAND EDGE, μM		FLATNESS,* % OF PASSBAND (SPEC ≥ 0.75)	ESTIMATED SPURIOUS SYSTEM RESPONSE, %
	LOWER	UPPER	LOWER	UPPER		
1	0.45 ± 0.01	0.52 ± 0.01	0.452	0.518	0.77	< 5
2	0.52 ± 0.01	0.60 ± 0.01	0.528	0.609	[0.71]	< 5
3	0.63 ± 0.02	0.69 ± 0.01	0.613	0.687	[0.67]	< 5
4	0.76 ± 0.02	0.90 ± 0.01	0.768	0.892	0.79	< 5
5	1.55 ± 0.02	1.75 ± 0.02	1.557	1.763	0.85	< 5
6	10.4 ± 0.10	12.5 ± 0.10	10.45	12.43	[0.69]	< 5
7	2.08 ± 0.03	2.35 ± 0.03	2.084	2.327	[0.59]	< 5

NOTE:

1) PERFORMANCE MEETS SPEC EXCEPT WHERE INDICATED BY [ ]. WAIVERS HAVE BEEN APPROVED.

2) EDGE SLOPE SPEC MET IN ALL CASES EXCEPT BAND 6 UPPER, 5 TO 75%

*WITH LINEAR CORRECTION

SPECTRAL COVERAGE

SBRC

- SPECTRAL COVERAGE PERFORMANCE CONSISTENT WITH SPECIFICATION REQUIREMENTS AS MODIFIED BY APPROVED WAIVERS

SPECTRAL MATCHING TEST

SBRC
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HUGHES AIRCRAFT COMPANY

PURPOSE: FIND CHANNEL-TO-CHANNEL VARIATIONS CAUSED BY CHANGE IN SPECTRAL SLOPES.

- INITIAL TEST COMPARED RESPONSE TO 48 IN 15 WITH RESPONSE TO A DIFFERENT SOURCE WITH SPECTRAL SHAPING FILTERS VIEWED THROUGH A COLLIMATOR.

- LARGE VARIATIONS IN RESULTS APPEARED PARTIALLY DUE TO SPATIAL RATHER THAN SPECTRAL DIFFERENCE. SECOND TEST USED THE COLLIMATOR SOURCE WITH TWO SETS OF SPECTRAL SHAPING FILTERS.

- FINAL RESULTS:
  BANDS 2, 3, 5 AND 7 WITHIN SPECIFICATION (< 0.5% VARIATION)
  BAND 1, 0.65% VARIATION
  BAND 4, 1.35% VARIATION

FLIGHT MODEL
THEMATIC MAPPER BAND
AVERAGE SWR (3.2.5)

SBRC
A SUBSIDIARY OF
HUGHES AIRCRAFT COMPANY

RESULTS OF BL 16/17 3 SEP '82 THERMAL VACUUM

BAND	30 METER BAR $\overline{SWR}$	σ	45 METER BAR $\overline{SWR}$	σ	60 METER BAR $\overline{SWR}$	σ	500 METER BAR $\overline{SWR}$	σ
1	0.42	0.01	0.79	0.03	0.96	0.02	1.0	0.0
2	0.41	0.01	0.83	0.02	0.98	0.01	1.0	0.0
3	0.39	0.01	0.81	0.02	0.97	0.01	1.0	0.0
4	0.40	0.02	0.83	0.03	0.98	0.02	1.0	0.0
5	0.44	0.03	0.81	0.04	0.97	0.03	1.0	0.0
7	0.42	0.01	0.82	0.03	0.96	0.02	1.0	0.0
SPEC	0.35		0.70		0.85		1.0	

BAND	120 METER BAR $\overline{SWR}$	σ	177 METER BAR $\overline{SWR}$	σ	240 METER BAR $\overline{SWR}$	σ	2000 METER BAR $\overline{SWR}$	σ
6	0.43	0.02	0.74	0.02	0.90	0.02	1.0	0.0

NOTE: BEFORE DECONVOLUTION OF CALIBRATION BLUR. DECONVOLUTION OF THE CALIBRATOR BLUR WOULD INCREASE THE 30M SWR BY A FACTOR OF 1.15.

9/82
21170-28

FLIGHT MODEL
SQUARE WAVE RESPONSE
(BEFORE REFOCUS 2 SEPT. 1982)

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CHANNEL NO.	BAND NO. 1	2	3	4	5	7	6
1	0.411	0.384		0.374	0.369	0.401	
2	0.403	0.395		0.392	0.400	0.409	
3	0.429	0.409		0.374	0.345	0.409	
4	0.414	0.401		0.383	0.371	0.426	
5	0.407	0.387		0.372	0.356	0.402	
6	0.398	0.419		0.404	0.358	0.417	
7	0.411	0.399		0.392	0.339	0.376	
8	0.415	0.420		0.370	0.374	0.393	
9	0.422	0.408		0.384	0.349	0.367	
10	0.433	0.392		0.388	0.372	0.402	
11	0.425	0.401		0.386	0.377	0.389	
12	0.418	0.427		0.400	0.410	0.420	
13	0.403	0.407		0.384	0.361	0.393	
14	0.428	0.428		0.425	0.347	0.412	
15	0.408	0.404		0.397	0.336	0.360	
16	0.396	0.420		0.411	0.366	0.362	
AVERAGE	0.414	0.406		0.390	0.364	0.396	
σ	0.011	0.014		0.015	0.020	0.021	

FLIGHT MODEL
SQUARE WAVE RESPONSE
(AFTER REFOCUS 3 SEPT. 1982)

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CHANNEL NO.	BAND NO. 1	2	3	4	5	7	6
1	0.415	0.390	0.390	0.382	0.426	0.412	0.424
2	0.409	0.401	0.385	0.405	0.421	0.396	0.435
3	0.421	0.418	0.389	0.381	0.418	0.419	0.407
4	0.413	0.408	0.398	0.390	0.421	0.439	0.443
5	0.406	0.395	0.395	0.385	0.411	0.412	
6	0.409	0.419	0.385	0.411	0.430	0.450	
7	0.404	0.408	0.394	0.398	0.432	0.430	
8	0.422	0.427	0.394	0.370	0.417	0.428	
9	0.431	0.421	0.400	0.390	0.444	0.420	
10	0.428	0.403	0.383	0.390	0.459	0.438	
11	0.420	0.404	0.376	0.388	0.471	0.431	
12	0.411	0.432	0.388	0.408	0.517	0.427	
13	0.423	0.414	0.388	0.386	0.447	0.429	
14	0.423	0.435	0.394	0.427	0.439	0.433	
15	0.408	0.402	0.404	0.404	0.443	0.409	
16	0.413	0.425	0.401	0.413	0.427	0.405	
AVERAGE	0.416	0.413	0.392	0.396	0.439	0.424	0.427
σ	0.008	0.013	0.007	0.015	0.026	0.014	0.016

SQUARE WAVE RESPONSE IN THERMAL VACUUM

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(VERSUS NASA SPECIFICATIONS AT 30 METER BAR WITH DECONVOLUTION OF CALIBRATOR - 2 BLUR)

BAND	30 METER BAR BAND AVERAGE SWR BEFORE DECONVOLUTION	30 METER BAR BAND AVERAGE SWR AFTER DECONVOLUTION	NASA 30 METER BAR SPECIFIED SWR
1	0.416	0.452	0.35
2	0.412	0.447	0.35
3	0.391	0.425	0.35
4	0.395	0.429	0.35
5	0.439	0.477	0.35
7	0.424	0.461	0.35
6	0.427 (120 μ BAR)	0.464	0.35

SQUARE WAVE RESPONSE VS SPATIAL FREQUENCY BAND 1

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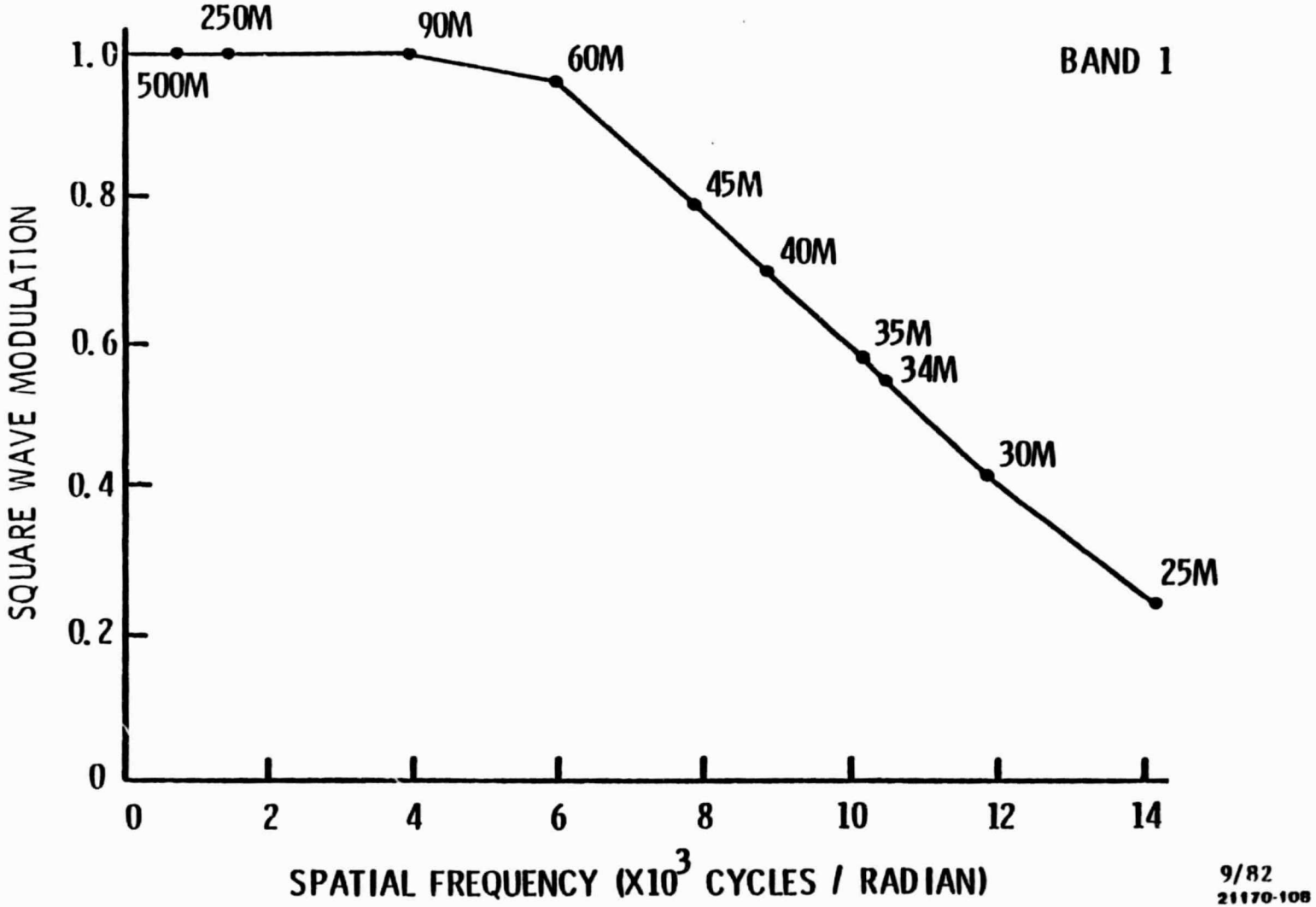

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SQUARE WAVE RESPONSE VS SPATIAL FREQUENCY BAND 2

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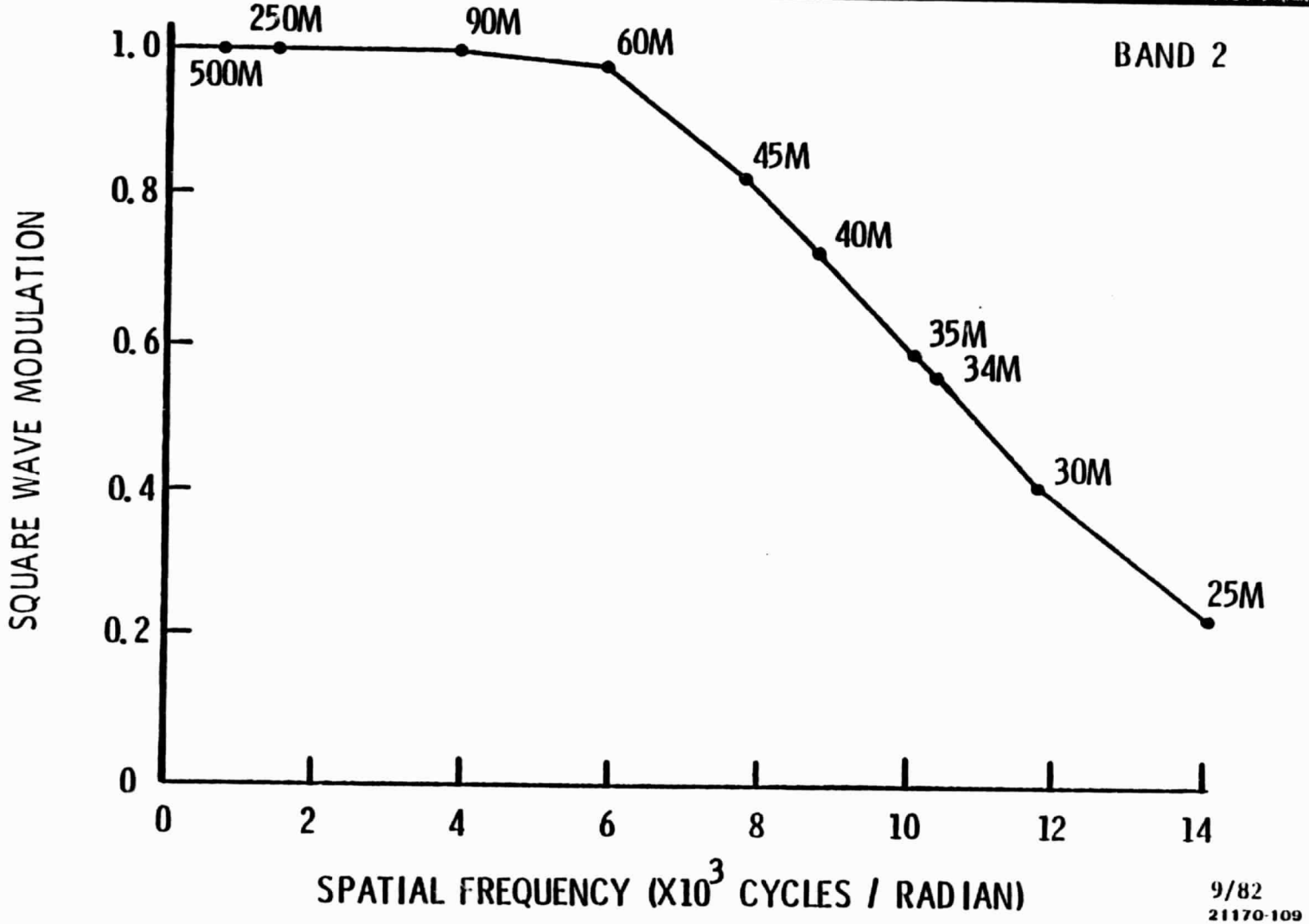

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SQUARE WAVE RESPONSE VS SPATIAL FREQUENCY BAND 3

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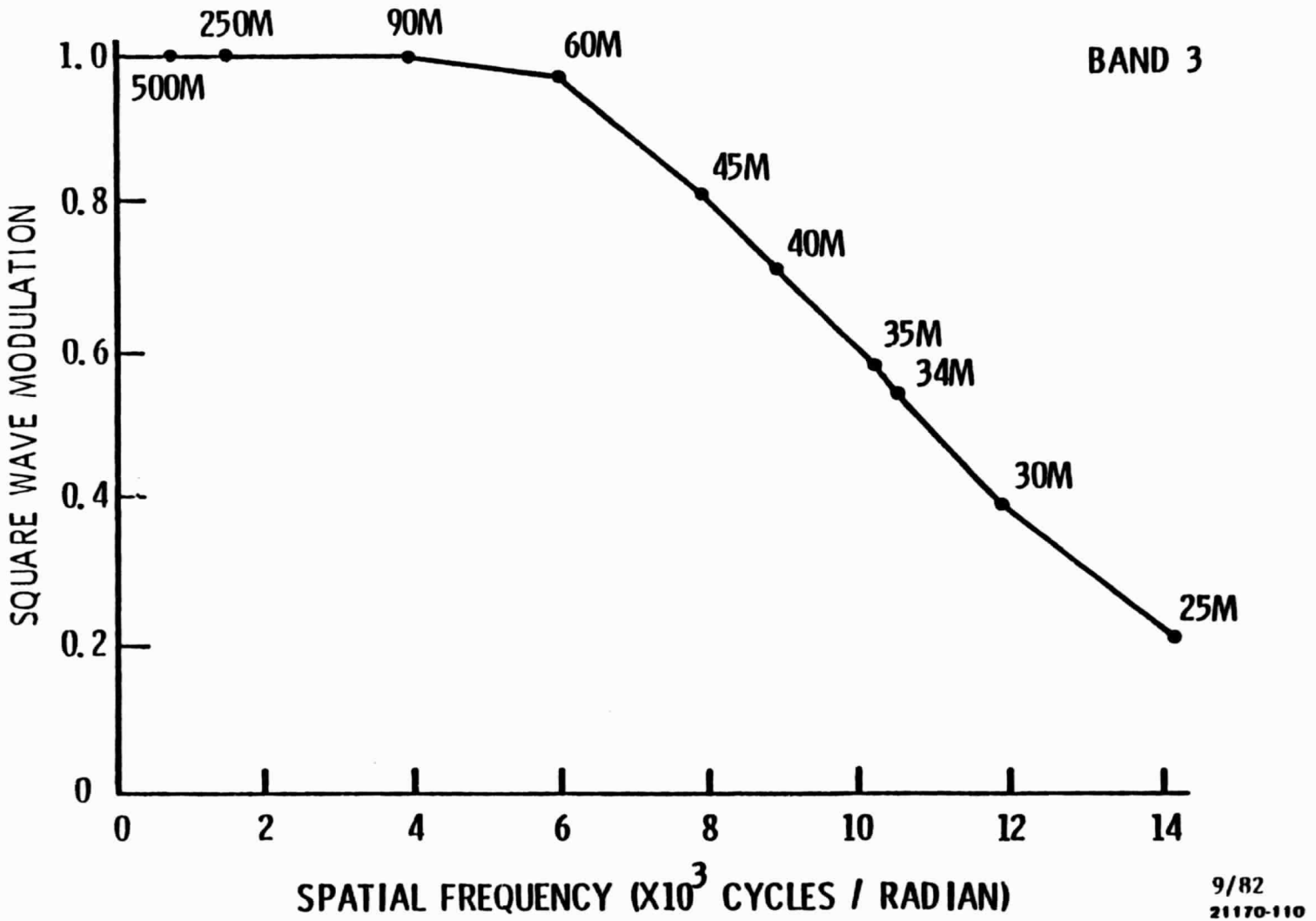

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SQUARE WAVE RESPONSE VS SPATIAL FREQUENCY BAND 4

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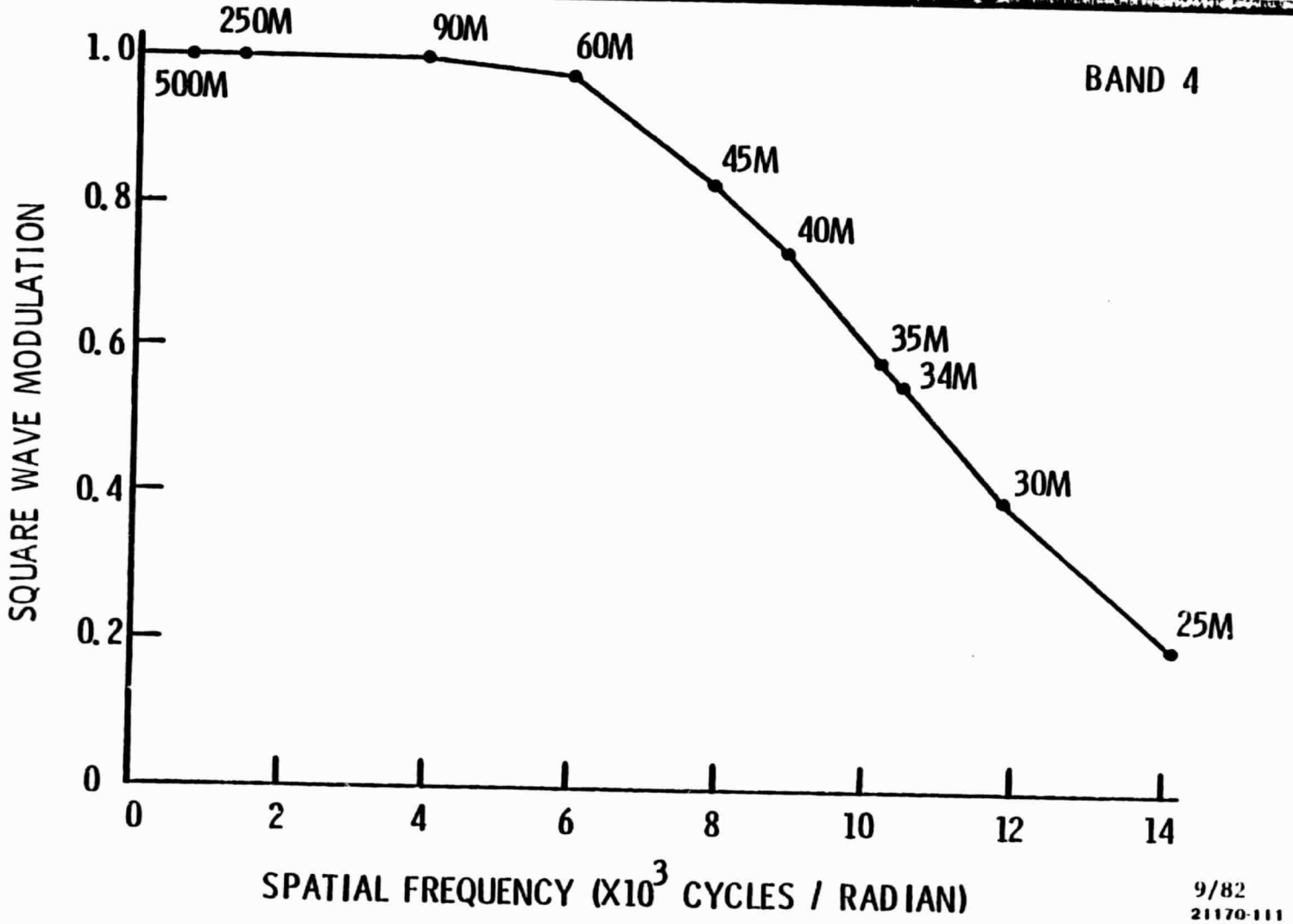

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SQUARE WAVE RESPONSE VS SPATIAL FREQUENCY BAND 5

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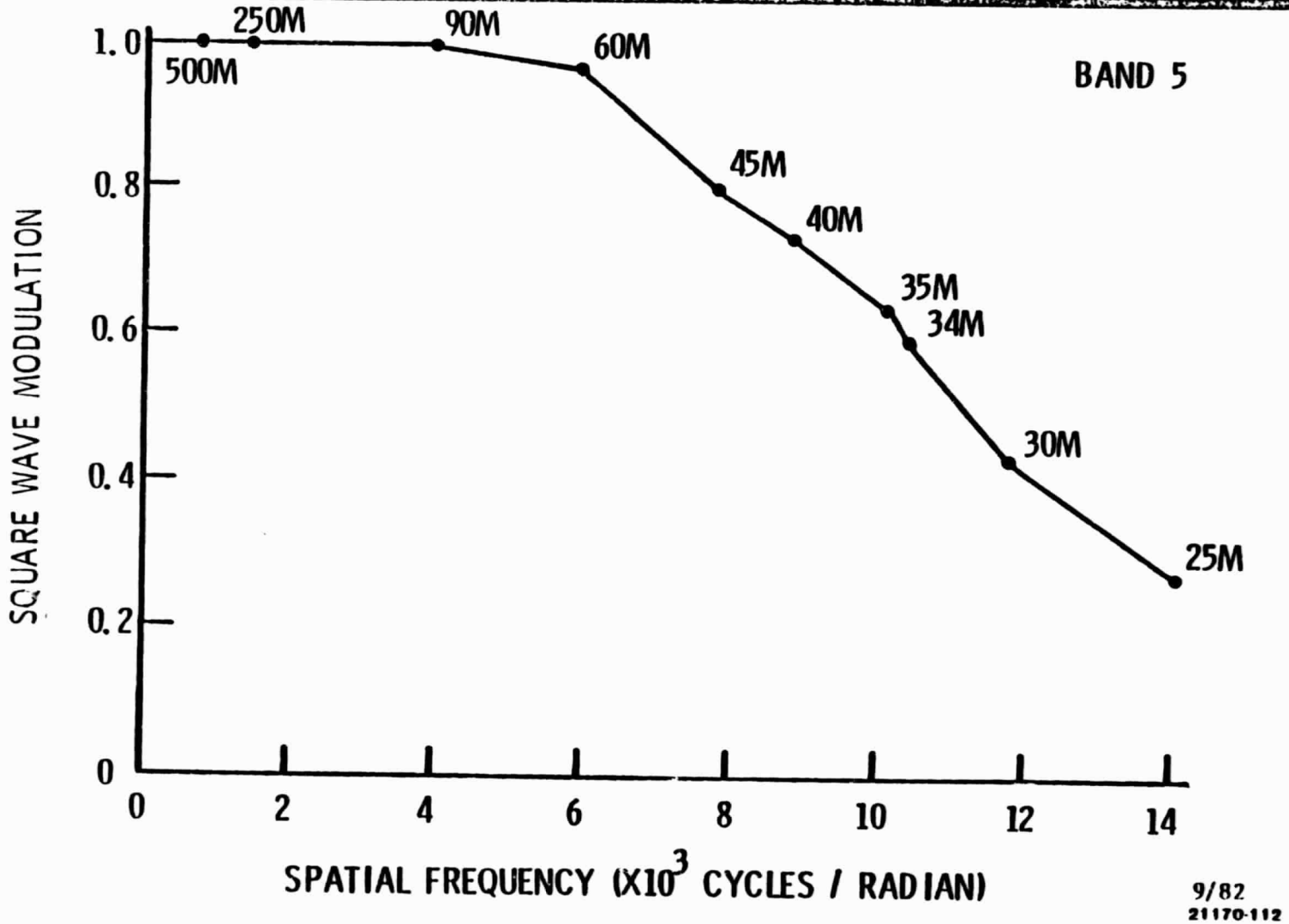

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SQUARE WAVE RESPONSE VS SPATIAL FREQUENCY BAND 7

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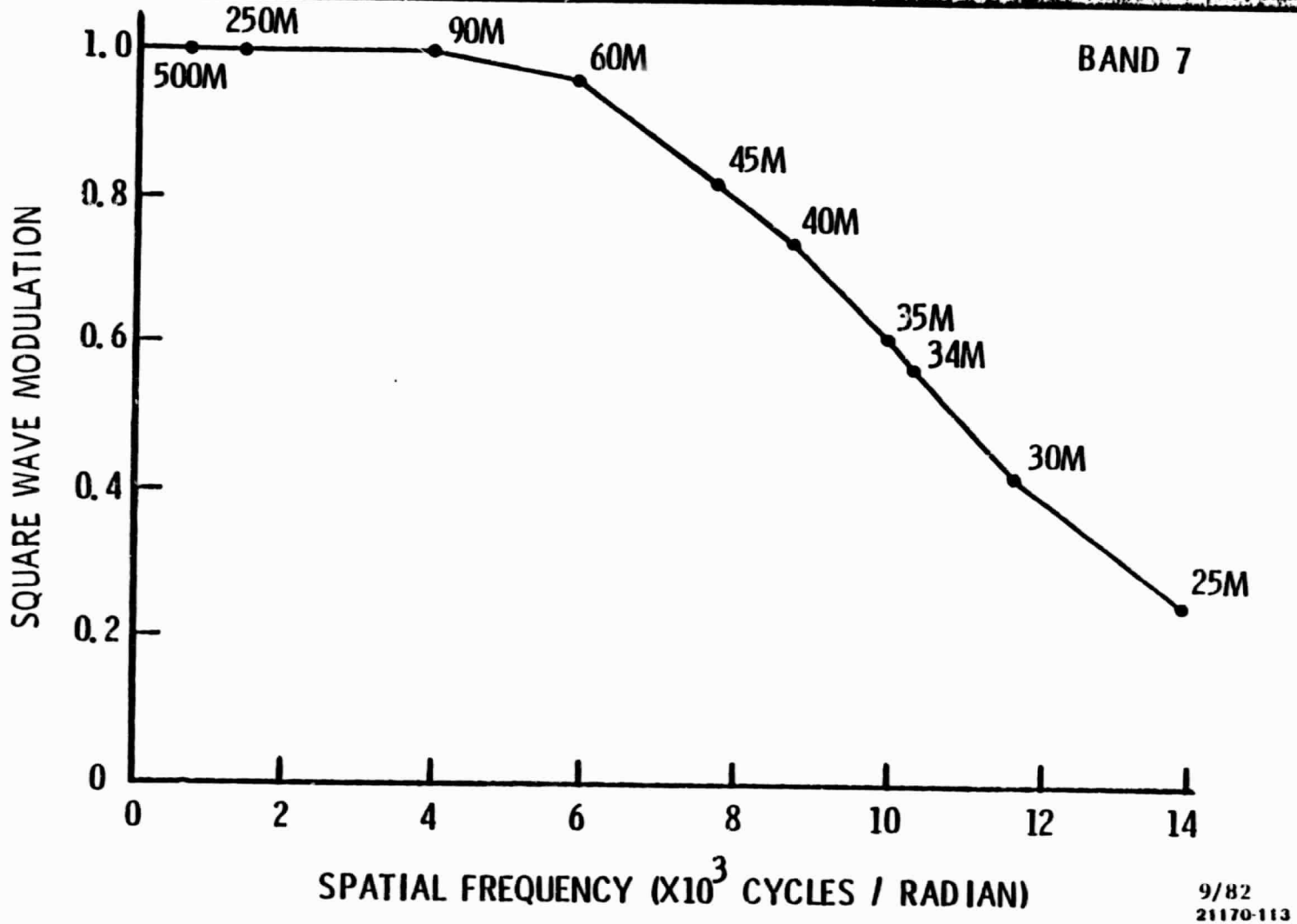

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SQUARE WAVE RESPONSE SUMMARY

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SQUARE WAVE RESPONSE REQUIREMENTS HAVE BEEN MET IN ALL CHANNELS OF ALL BANDS AT ALL SPATIAL FREQUENCIES

- CHANNEL-TO-CHANNEL RESPONSE WITHIN A BAND WELL BEHAVED
- SHAPE OF SWR VS SPATIAL FREQUENCY SIMILAR FOR ALL BANDS
- BOTH FOCAL PLANES OF TM LOCATED VERY CLOSE TO OPTIMAL FOCUS
- DECONVOLUTION OF CALIBRATOR MTF WOULD INCREASE 30 METER SWR BY APPROXIMATELY 15%

F1/PF THERMAL COMPARISON

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TLM CHANNEL	DESCRIPTION OF SENSOR LOCATION	BOL/10% D.C.		EOL/40% D.C.	
		PF(LO)	F1(LO)	PF(HI)	F1(LO)
12	SCAN MIRROR ELECTRONICS	22.7°C	22.8°C	27.8°C	28.2°C
18	SCAN MIRROR INTERFACE	22.6	21.9	24.4	24.4
27	Si PREAMPLIFIERS	6.9	7.5	43.5	43.1
39	SCAN LINE CORRECTOR	11.1	12.8	29.3	30.4
50	SILICON FPA	8.6	8.9	26.8	24.7
51	MUX POWER SUPPLY	12.8	12.6	47.0	45.3
67	POWER SUPPLY RAD	15.0	14.0	28.9	27.2
79	SECONDARY MIRROR	18.4	17.8	21.2	20.3
83	COOLED PREAMPLIFIERS	-4.0	-6.0	11.6	8.1
87	PRIMARY MIRROR	11.3	10.0	18.4	15.9
95	TELESCOPE HOUSING	10.6	14.7	17.8	18.4
103	COOLER AMBIENT STAGE	-11.7	-13.6	-2.5	-6.4
250	TELESCOPE TUBE	15.9	18.9	19.9	22.4

COMMANDS AND TELEMETRY

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- ALL COMMANDS EXECUTED PROPERLY AT ALL TIMES
- ALL DIGITAL AND ACTIVE ANALOG TELEMETRY FUNCTIONED PROPERLY AT ALL TIMES
- ALL PASSIVE ANALOG TELEMETRY FUNCTIONED PROPERLY WITH TWO EXCEPTIONS:
  - TELESCOPE BASEPLATE TEMPERATURE CHANNEL FAILED DURING TRANSPORTATION
  - RELAY OPTICS TEMPERATURE CHANNEL DID NOT FUNCTION DURING MOST OF THERMAL VACUUM TEST. PROBLEM DISAPPEARED WHEN END-BELL LOWERED. TEST CABLES A POSSIBLE CAUSE OF PROBLEM

C-3

POWER CONSUMPTION WATTS (3.3.4.3)

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PICTURE MODE		INTERNAL STANDBY MODE	
MINIMUM	PEAK	MINIMUM	PEAK
261	344	62	117

- MEASUREMENT AT 28V
- AVERAGE POWER DEPENDS ON PICTURE MODE DUTY CYCLE
- FLIGHT MODEL IS ESSENTIALLY THE SAME AS PROTOFLIGHT

SCAN LINE LENGTH

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	SME 1	SME 2
FORWARD		
AVERAGE	60742.9 μS	60742.9 μS
MAX	60748.7	60751.1
MIN	60737.2	60734.9
σ	2.4	2.6
REVERSE		
AVERAGE	60742.9	60742.9
MAX	60749.8	60751.1
MIN	60735.6	60738.1
σ	2.5	2.6

400 SCAN STATISTICS (TYPICAL)

LINE LENGTH ERROR - SME 1

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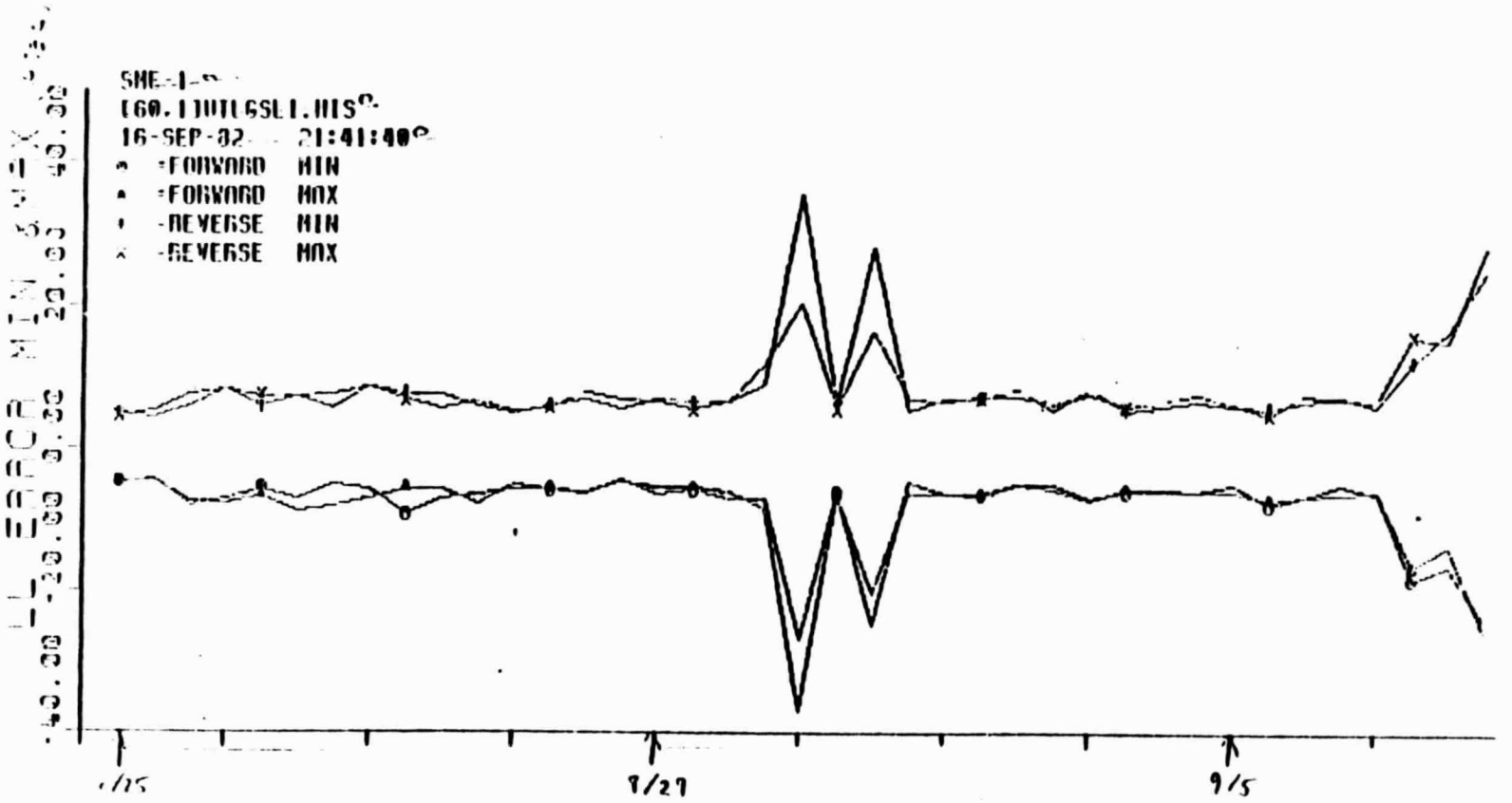

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LINE LENGTH ERROR - SME 2

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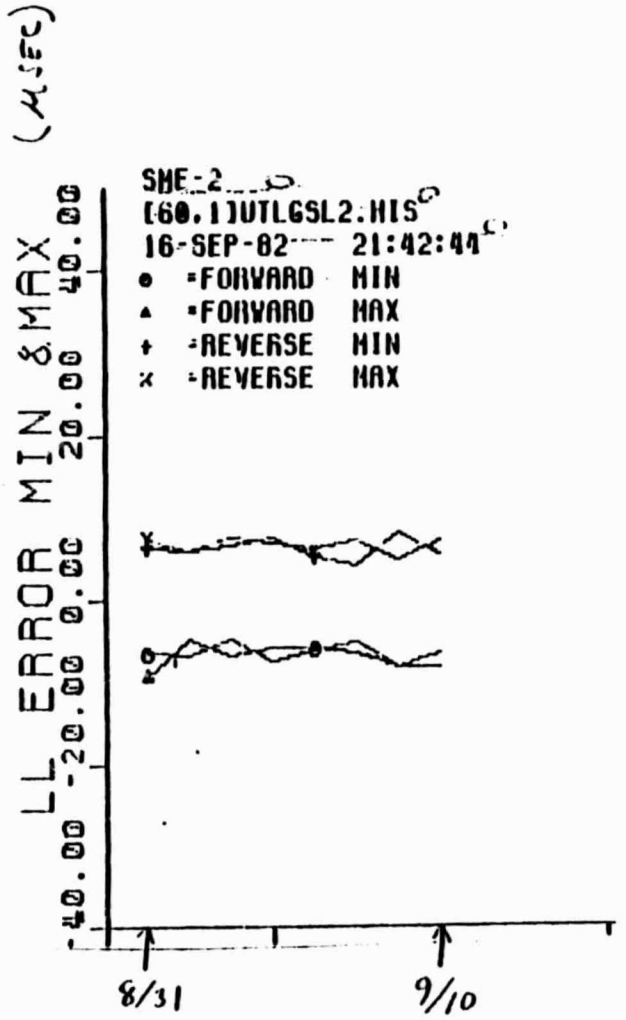

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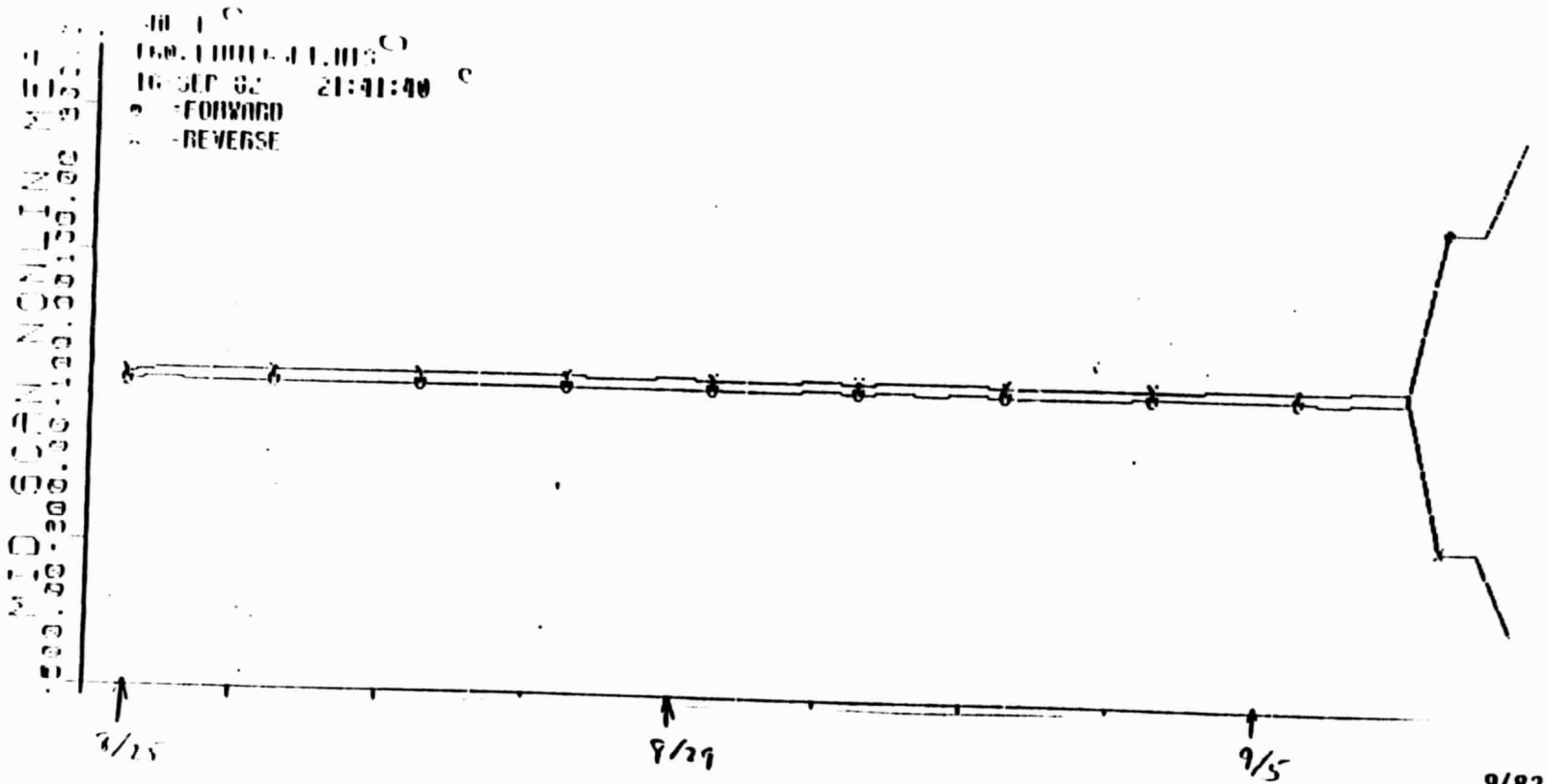
MIDSCAN LINEARITY - SME 1



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MIDSCAN LINEARITY - SME 2

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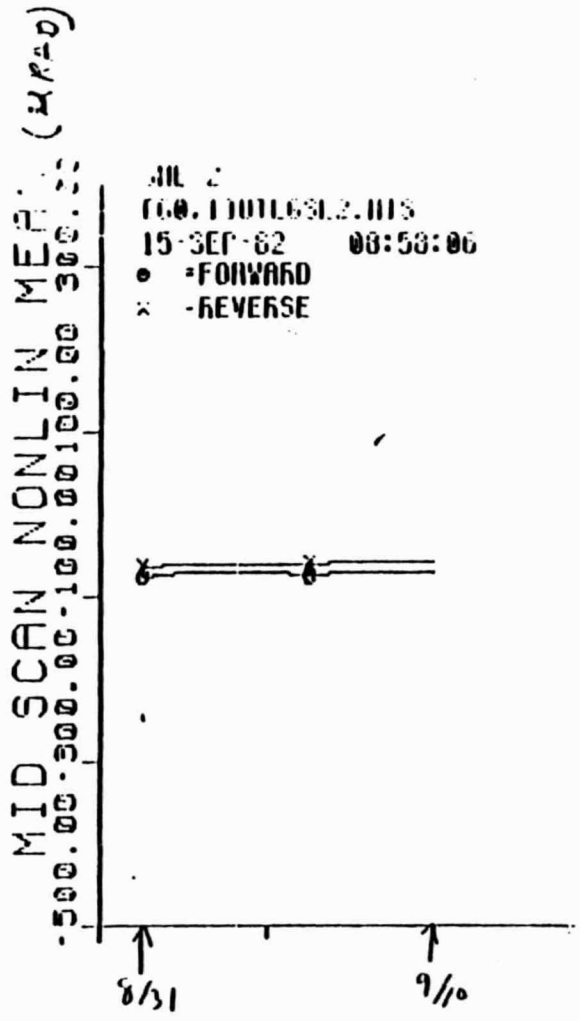

MIDSCAN LINEARITY HISTORY
AMBIENT ENVIRONMENT

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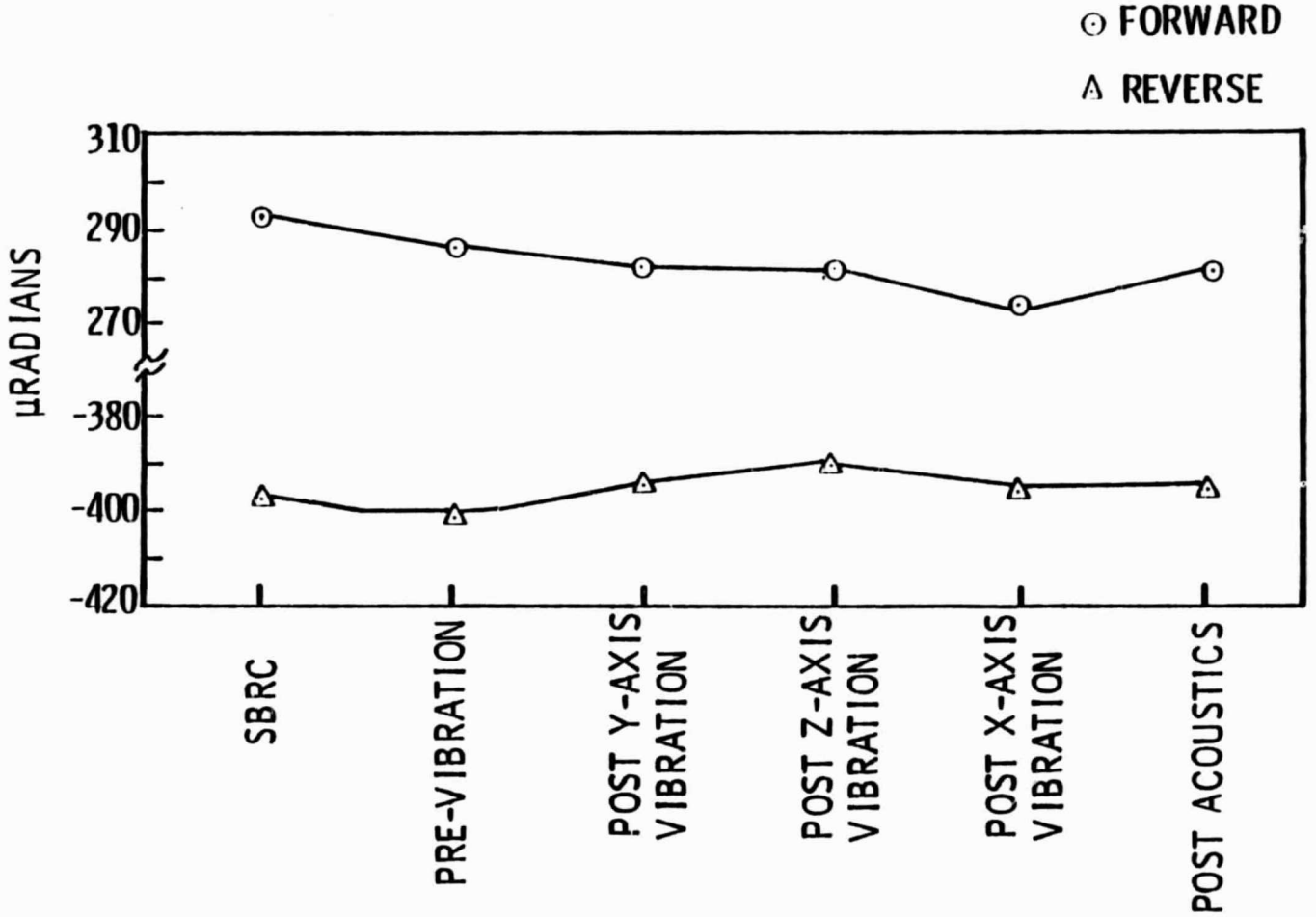

ALONG SCAN PROFILE AS MEASURED IN BL 19/20 SME-1

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DEVIATION FROM SMA ACCEPTANCE TEST PROFILE

DEVIATIONS (μ RADIANS)

FORWARD SCAN

+10
0
-10
1000
2000
3000
4000
5000
6320
MINOR FRAME

REVERSE SCAN

+10
0
-10
1000
2000
3000
4000
5000
6320
6320-MF

● FULL BL19/20 ▽△*MINI BL19/20's

9/82
9-34

SLC SCAN PROFILES

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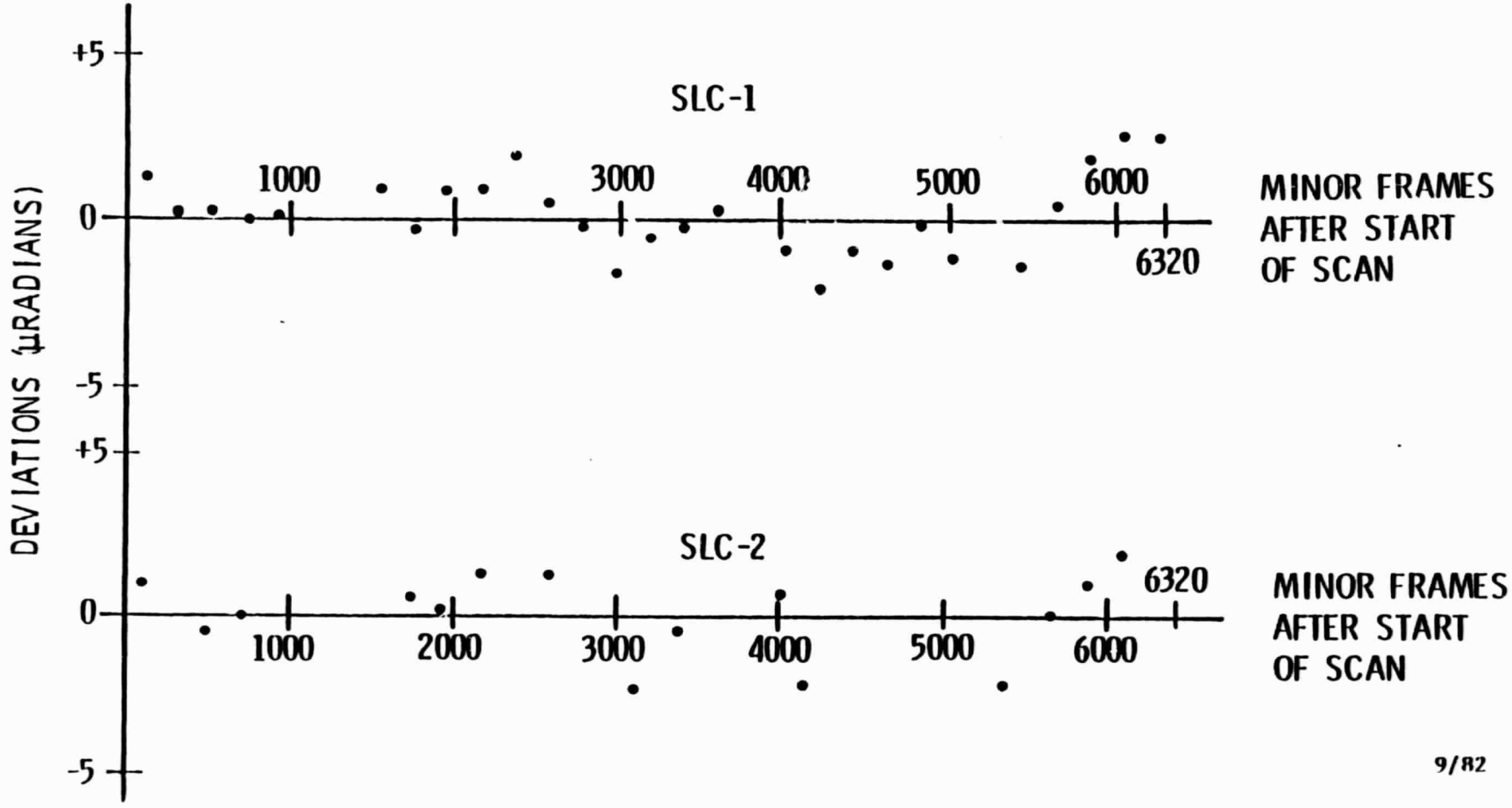
DEVIATIONS FROM THE IDEAL LINEAR SWEEP (9.610 mRAD/SEC)



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CROSS SCAN PROFILE AS MEASURED IN BL 19/20 SME-1 SLC OFF

SBRC
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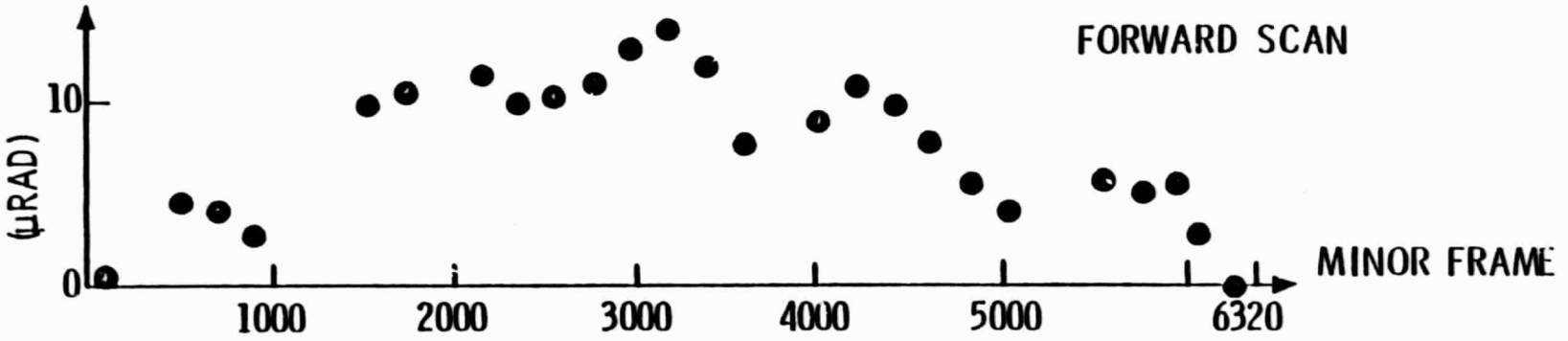
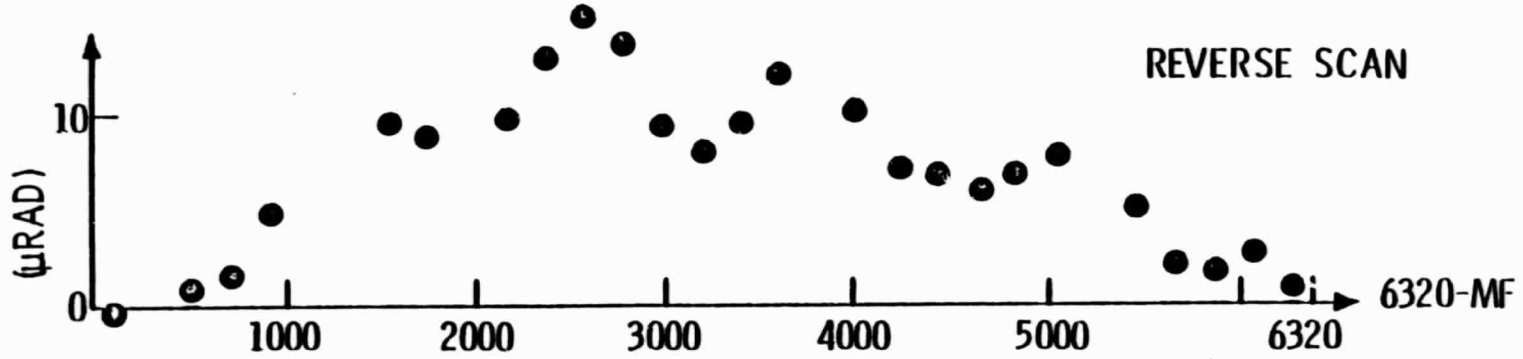
HUGHES AIRCRAFT COMPANY





CROSS SCAN BAND TO BAND REGISTRATION

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BAND 1 "DETECTOR 9.00" IS ALIGNED WITH:

BAND	"DETECTOR"
2	9.00
3	8.97
4	8.96
5	9.07
7	9.08

F-1 THEMATIC MAPPER - THERMAL VACUUM
IFOV DYNAMIC REGISTRATION ALONG - SCAN
VERSUS BAND 4, CHANNEL 9 REFERENCE

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UNITS ARE IFOV

BAND	CHANNEL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Fwd. Scan	.24	.25	.23	.24	.27	.22	.22	.21	.23	.22	.23	.24	.27	.20	.28	.23
	Rev. Scan	-.16	-.15	-.20	-.14	-.18	-.19	-.23	-.20	-.22	-.19	-.21	-.17	-.17	-.19	-.16	-.17
2	Fwd. Scan	-.04	.01	-.05	-.04	-.01	-.01	-.04	-.03	-.05	-.03	-.06	-.03	-.03	.01	-.04	-.05
	Rev. Scan	.11	.17	.10	.13	.14	.15	.09	.12	.08	.12	.06	.13	.11	.17	.09	.11
3.	Fwd. Scan	-.02	-.02	-.01	-.02	-.04	-.05	-.01	-.07	-.04	-.04	-.01	-.04	.04	-.03	.03	-.04
	Rev. Scan	.10	.16	.11	.15	.07	.11	.11	.10	.07	.12	.10	.13	.16	.14	.15	.13
4.	Fwd. Scan	.03	.03	.03	.03	.02	-.03	-.02	.00	.00	-.02	.00	-.03	.02	.00	.06	.01
	Rev. Scan	.06	.07	.06	.08	.04	.01	.00	.04	.00	.01	.01	.01	.04	.04	.06	.06
5.	Fwd. Scan	.29	.09	.26	.11	.15	.18	.16	.18	.20	.19	.16	.11	.16	.14	.12	.12
	Rev. Scan	.02	.09	.05	.10	-.04	.17	-.02	.18	.02	.22	.02	.14	.01	.19	-.04	.22
7.	Fwd. Scan	-.03	-.17	-.10	-.11	-.08	-.13	-.06	-.10	.01	-.12	-.04	-.19	-.11	-.18	-.10	-.17
	Rev. Scan	.17	.32	.18	.36	.23	.34	.26	.39	.33	.38	.29	.34	.24	.37	.23	.44

NOTE ON SIGN CONVENTIONS: Bands 1 and 4 are separated by about 75.2 minor frames in both forward and reverse scans.

INTERNAL/EXTERNAL GAIN RATIO

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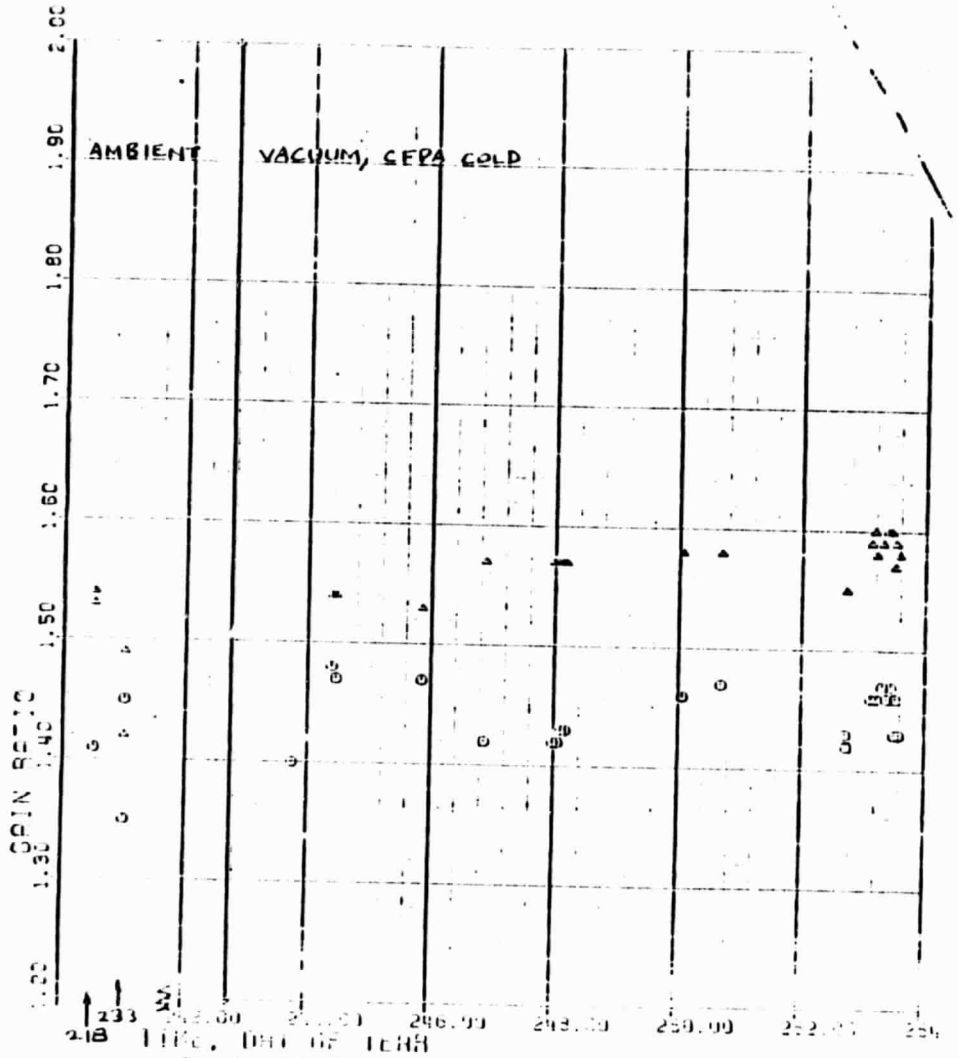
- EXTERNAL GAIN = DIFFERENCE IN OUTPUT COUNTS DIVIDED BY DIFFERENCE IN INPUT SPECTRAL RADIANCE FROM TWO EXTERNAL SOURCES.
- INTERNAL GAIN = DIFFERENCE IN OUTPUT COUNTS DIVIDED BY DIFFERENCE IN BLACKBODY SPECTRAL RADIANCE FROM THE INTERNAL BLACKBODY AND CALIBRATION SHUTTER.
- RATIO OF THESE GAINS IS A FUNCTION ONLY OF GEOMETRY AND MIRROR REFLECTANCES
- VARIATIONS ARE THOUGHT TO REPRESENT RANDOM ERROR AND SHUTTER SHIFT (TEMPERATURE CORRELATION NOT OBVIOUS)



INT/EXT GAIN RATIO VS TIME
TM FI BAND 6 CH. 1,2

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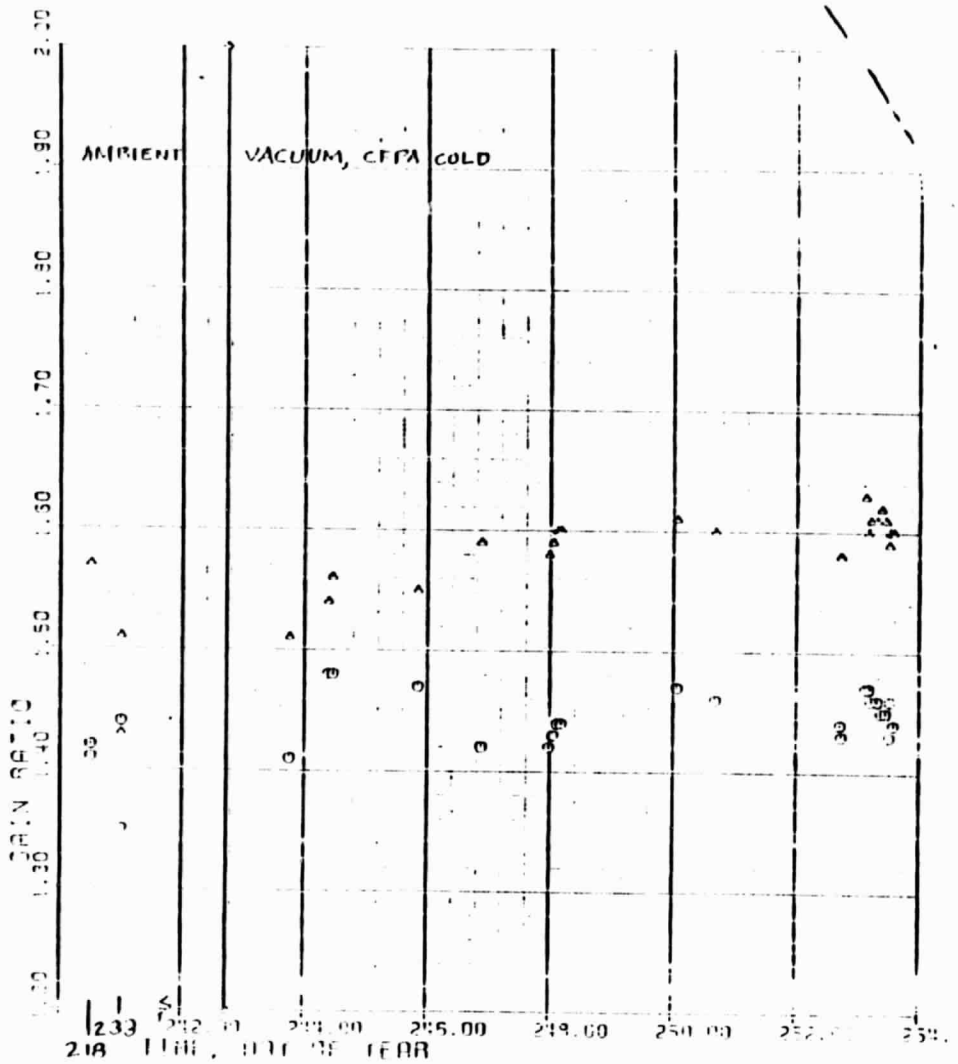
INTERIM/EXTERNAL GAIN RATIO VS TIME BAND 6 CH 1 & 2

9/82



INT/EXT GAIN RATIO VS TIME
IM FI BAND 6 CH. 3,4 ⊙,△

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INTERNAL/EXTERNAL GAIN RATIO VS TIME BAND 6 CH 3 & 4

9/82

BAND 6 LINEARITY

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- EXTERNAL MTF BLACKBODY SET AT 5 TEMPERATURES
- LINES OF REGRESSION FIT TO THESE DATA ARE:

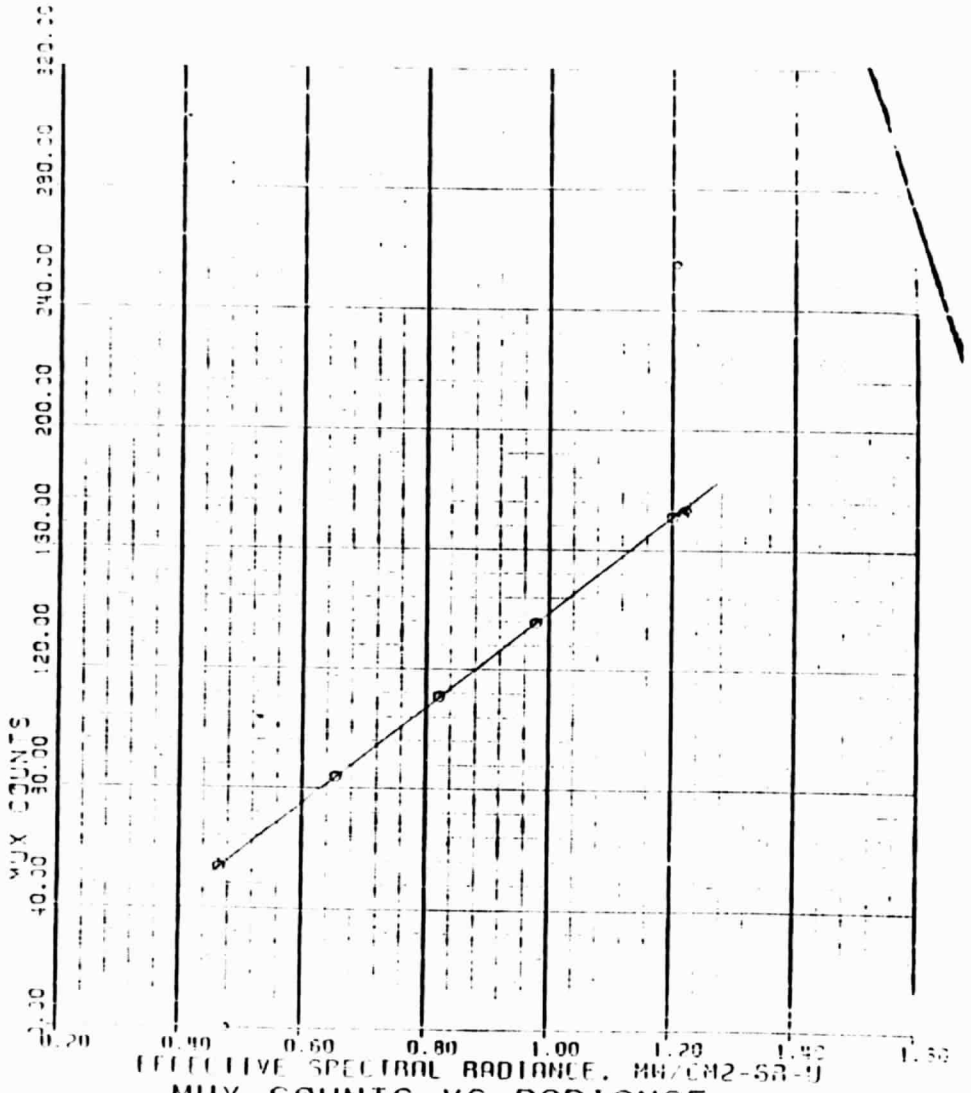
	CHANNEL			
	1	2	3	4
COEFFICIENT OF DETERMINATION	.99997	.99998	.99998	.99997
a, COUNTS	-20.72	-6.23	-13.75	-4.56
b, COUNTS (MW/cm^2-sr-μm)	159.71	140.25	149.99	137.92

WHERE COUNTS Q = a + bh (SPECTRAL RADIANCE)

- GAIN ALSO CALCULATED FOR FIRST 4 TEMPERATURES USING MTF AND REFERENCE BLACKBODIES
- AVERAGE GAIN, WEIGHTED FOR SEPARATION:

	CHANNEL			
	1	2	3	4
GAIN (AVERAGE)	157.1	138.3	148.2	135.8

- GAIN FROM REGRESSION HIGH BECAUSE OF RISING CALIBRATION SHUTTER TEMPERATURES



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MUX COUNTS VS RADIANCE BAND 6 CH 1

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CALIBRATION SHUTTER SIGNAL

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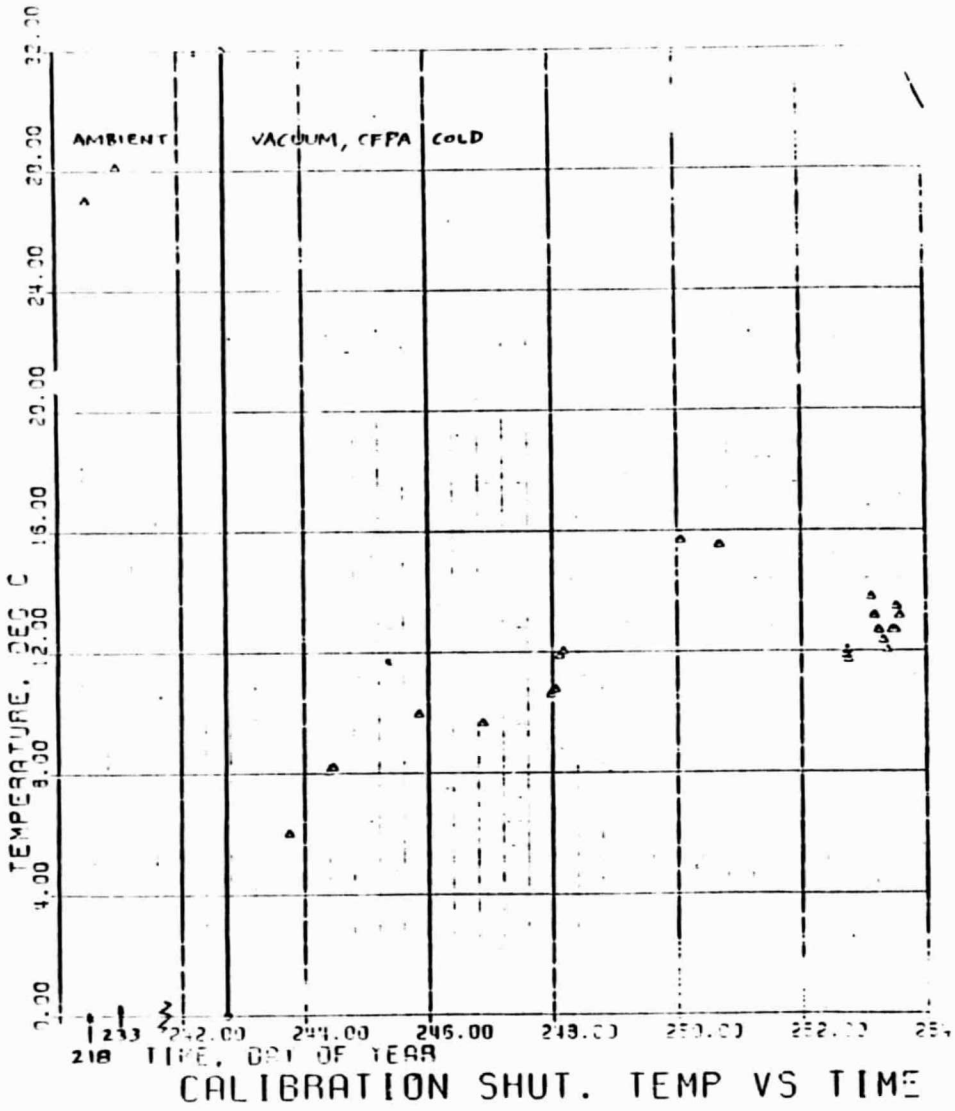
- SET BY THERMISTOR ON SHUTTER FLAG
- NOT A DIRECT FUNCTION OF RADIANCE
- LINEAR REGRESSION FIT TO SHUTTER OUTPUT COUNTS (Q_{sn}) VS SHUTTER TEMPERATURE (T_{sn}), 51 DATA POINTS:

CHANNEL	
1	$Q_{sn} = 29.19 + 4.612\ T_{sh}$
2	$Q_{sn} = 29.29 + 4.612\ T_{sh}$
3	$Q_{sn} = 29.34 + 4.612\ T_{sh}$
4	$Q_{sn} = 29.24 + 4.612\ T_{sh}$

- STATISTICS EXAMPLE:

  CHANNEL 1 COEFFICIENT OF DETERMINATION = 0.996

  STANDARD ERROR OF ESTIMATE = 0.15 COUNTS



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CALIBRATION SHUTTER TEMPERATURE VS TIME

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BAND 6 CALIBRATION

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- EXTERNAL CALIBRATOR WITH TWO ACCURATE BLACKBODIES IS STANDARD FOR SCENE RADIANCE.
- COMPARISON GIVES SCENE EQUIVALENT RADIANCES FOR THE CALIBRATION SHUTTER AND THE INTERNAL BLACKBODY.
- TRANSFER CHARACTERISTICS REGENERATED BY PLOTTING OUTPUT SIGNAL COUNTS VS SCENE EQUIVALENT RADIANCES FROM SHUTTER AND INTERNAL BLACKBODY.
- SHUTTER RADIANCE FUNCTION OF SHUTTER TEMPERATURE.
- SMALL VARIATION IN RADIANCE FROM INTERNAL BLACKBODY.
- LITTLE CORRELATION OF THIS VARIATION WITH SHUTTER TEMPERATURE.

BAND 6 CALIBRATION

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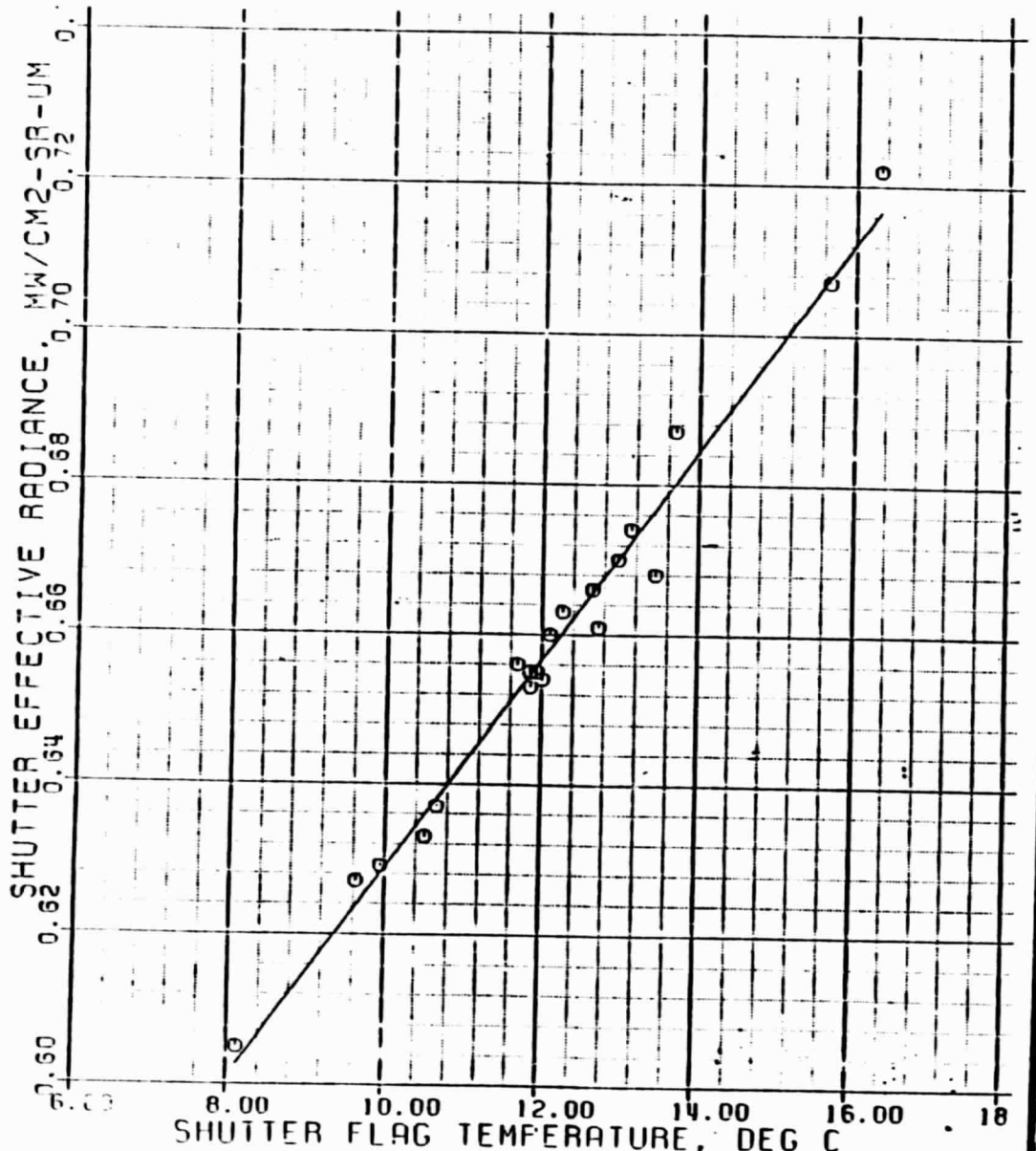
BAND 6 CALIBRATION (PARTIAL)

SHUTTER SCENE EQUIVALENT RADIANCE:

$$L_{Sh} = a + bT(^{\circ}C)$$

CHANNEL	1	2
a	0.4898	0.4661
b	0.01390	0.01475
COEF OF DETERM	0.979	0.983
INTERNAL BLACKBODY STANDARD DEVIATION	0.53K	0.42K



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SHUTTER RADIANCE VS TEMPERATURE BAND 6 CH 1

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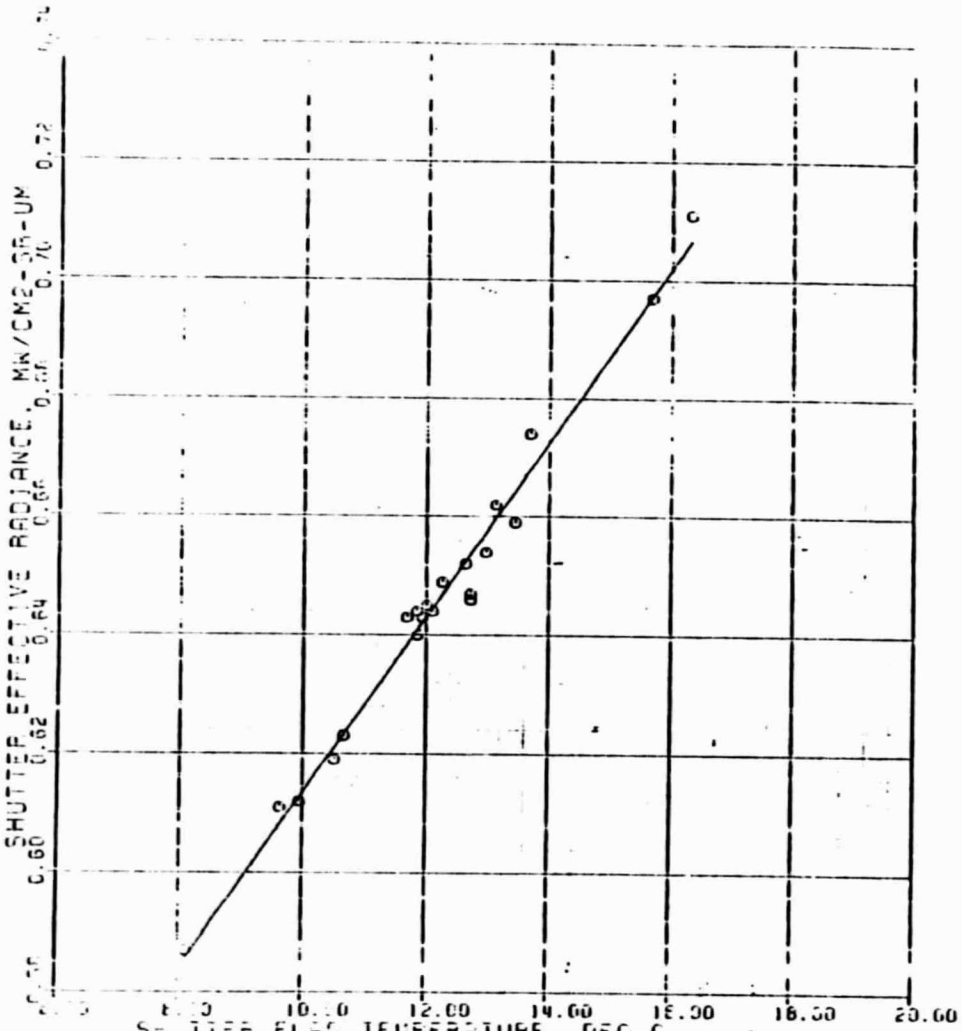

SHUTTER RADIANCE VS TEMPERATURE
TM F1 B6 CH 2

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SHUTTER RADIANCE VS TEMPERATURE BAND 6 CH 2

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BAND 6 GAIN FUNCTIONS

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- GAIN VS HEATER CURRENT: $G = a + bi^2$

	CHANNEL			
	1	2	3	4
COEFFICIENT OF DETERMINATION	0.996	0.9997	0.997	0.994
a	164.49	144.04	154.10	141.26
b	-0.2478	-0.2715	-0.2477	-0.2532

FROM SETS OF DATA AT 4 CURRENTS OVER SHORT TIME AND NEAR CONSTANT TEMPERATURE

- GAIN VS TEMPERATURE: $G = a + bT$

a	916.53	915.11	917.53	924.85
b	-7.6713	-7.8252	-7.7651	-7.9344

FROM SETS OF DATA AT TWO TEMPERATURES AND NEAR CONSTANT CURRENT

BAND 6 GAIN DRIFT

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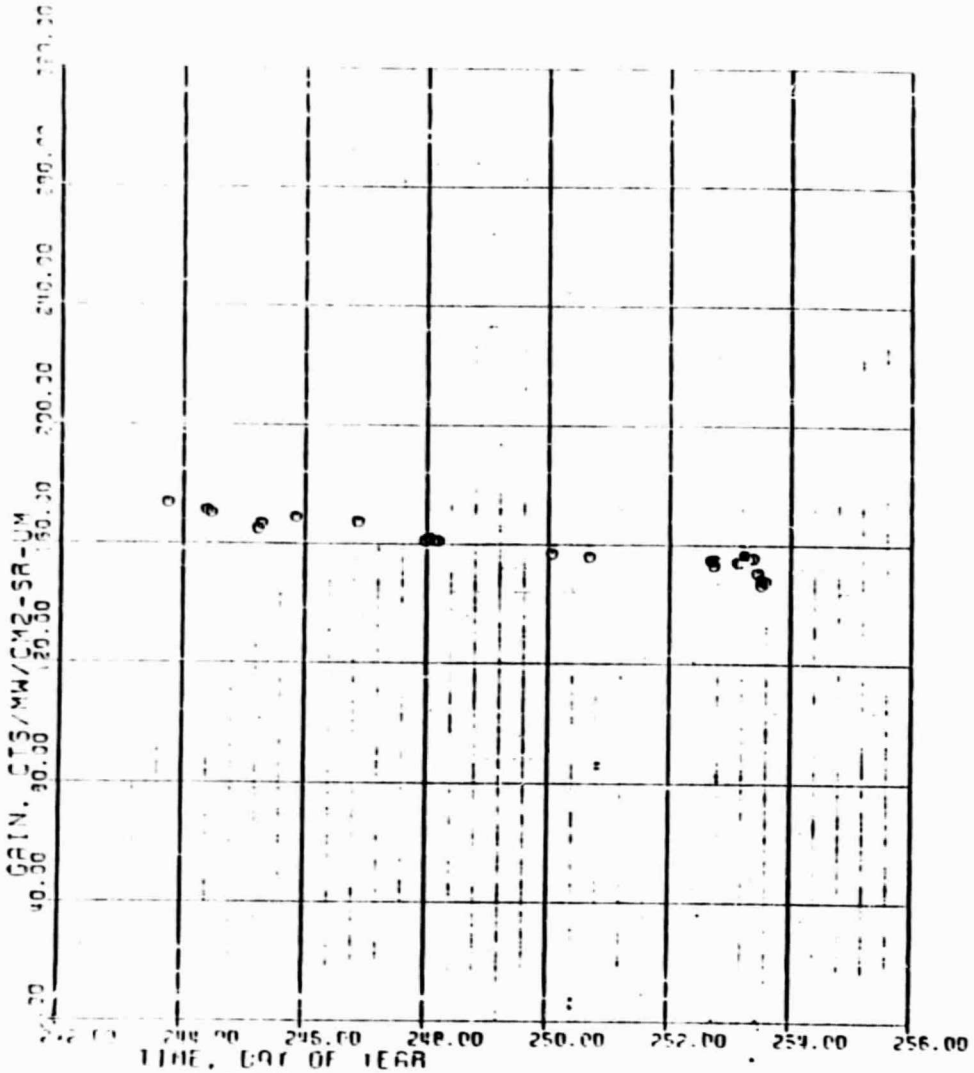
HUGHES AIRCRAFT COMPANY

- GAIN IS A FUNCTION OF COLD FOCAL PLANE TEMPERATURE AND CFP HEATER CURRENT
- SUBSETS OF GAIN DATA ARE SELECTED TO DETERMINE THESE FUNCTIONS
- GAIN MEASUREMENTS ARE ALL NORMALIZED TO 97K, 4 mA HEATER CURRENT, PLOTTED VS TIME
- BLACKED-IN DATA POINTS ARE TAKEN AT THE SAME TEMPERATURE AND HEATER CURRENT AS THE FIRST POINTS
- GAIN DOWNWARD DRIFT WITH TIME: 1.3% PER DAY



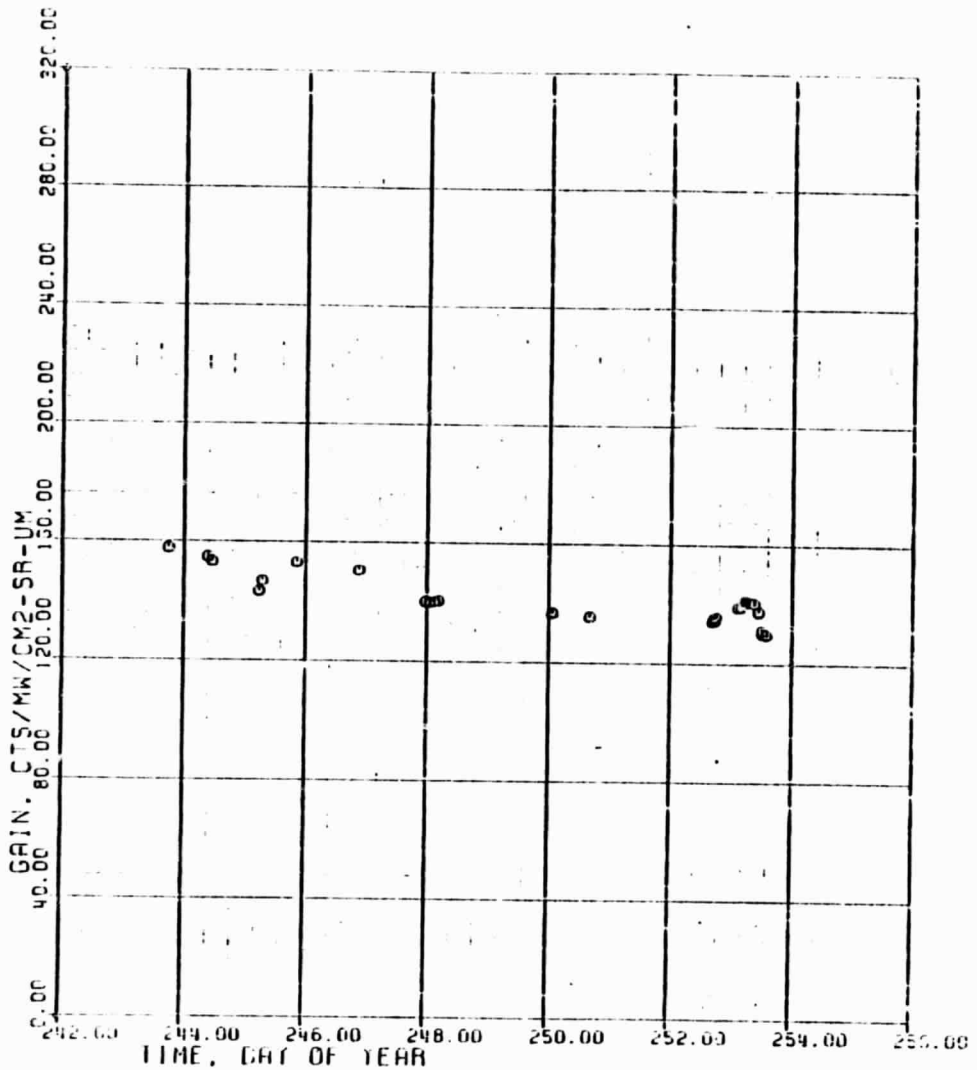
NORMALIZED GAIN VS TIME
TM F1 B6 CH1

SBRC

A SUBSIDIARY OF [illegible]

NORMALIZED GAIN VS TIME BAND 6 CH 1

9/82



NORMALIZED GAIN VS TIME
TM F1 B6 CH2

SBRC

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NORMALIZED GAIN VS TIME BAND 6 CH 2

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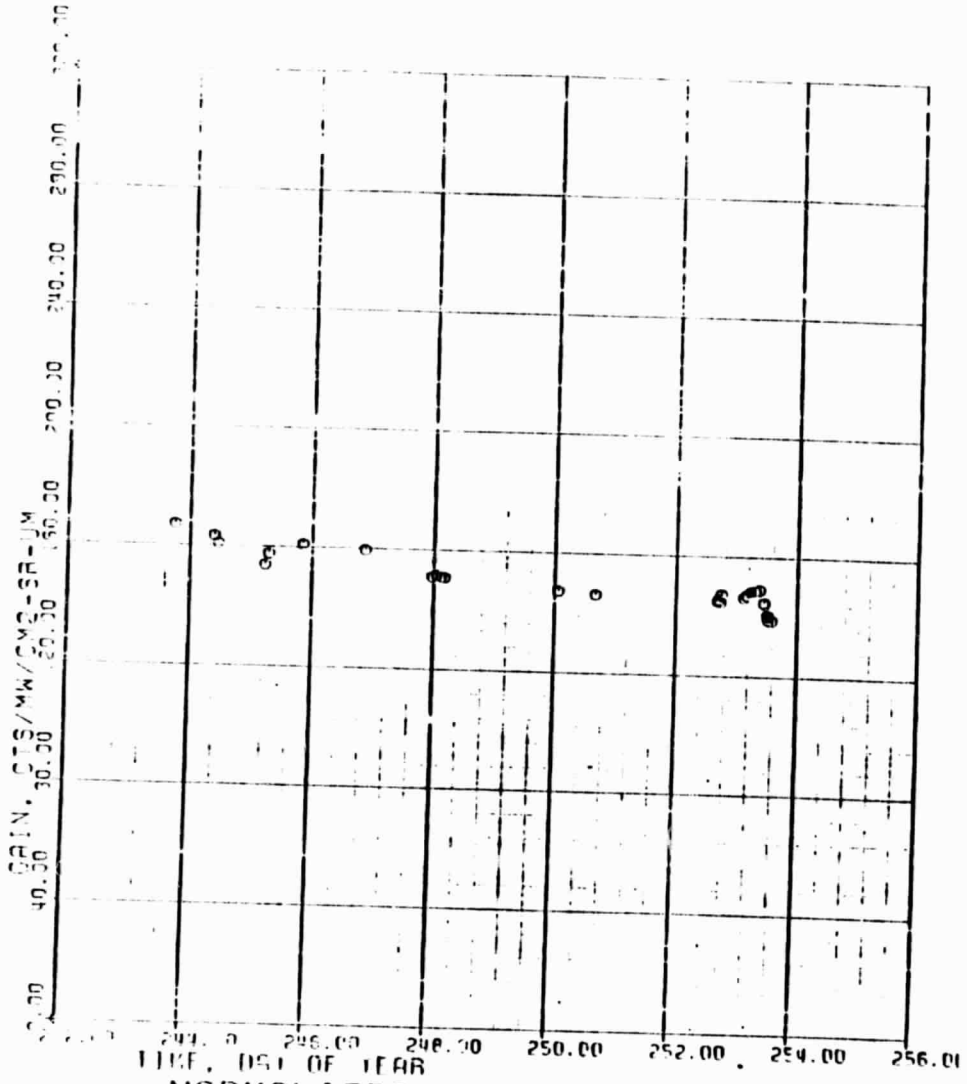

NORMALIZED GAIN VS TIME
TM F1 B6 CH3

SBRC

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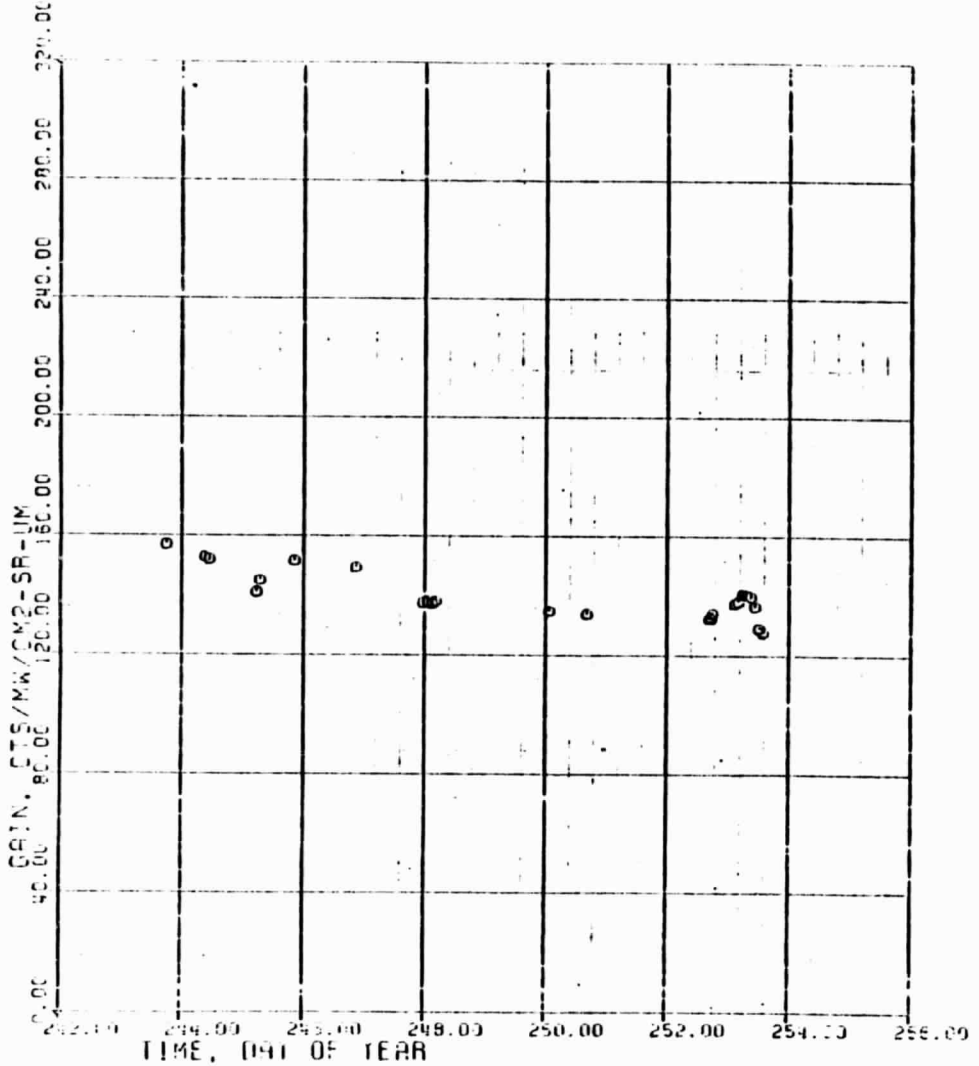
NORMALIZED GAIN VS TIME BAND 6 CH 3

9/82



NORMALIZED GAIN VS TIME
TM F1 B6 CH4

SBRC

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NORMALIZED GAIN VS TIME BAND 6 CH 4

9/82

FLIGHT MODEL RADIOMETRIC SENSITIVITY (3.2.9.1) (BAND AVERAGE)

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BAND	SCENE RADIANCE (mW/cm^2SR)		SNR				$NE\rho$ (%)	
			MINIMUM SCENE		MAXIMUM SCENE			
	MINIMUM SPECIFIED	MAXIMUM SPECIFIED	MEASURED	SPECIFIED	MEASURED	SPECIFIED	MEASURED	SPECIFIED
1	0.28	1.00	60.3	32	143.2	85	0.16	0.8
2	0.24	2.33	59.7	35	234.9	170	0.21	0.5
3	0.13	1.35	46.25	26	215.1	143	0.23	0.5
4	0.19	3.00	46.2	32	298.7	240	0.22	0.5
5	0.08	0.60	35.8	13	176.4	75	0.25	1.0
7	0.046	0.43	28.3	5	180.6	45	0.37	2.4
6	300K	320K	NEAT =	NEAT = 0.5K	NEAT =	NEAT = 0.42K		

INDEX G
SIGNAL TO NOISE RATIO

(cts), and noise (cts) at two radiance levels

BAND/ CHANNEL	CALCULATED VALUES LOW	CALCULATED VALUES HIGH	SPEC VALUES LOW	SPEC VALUES HIGH	CHANNELS OUT OF SPEC LOW	CHANNELS OUT OF SPEC HIGH
1/ 1	59.8111	142.656	32	85		
1/ 2	59.4141	145.642	32	85		
1/ 3	59.9211	142.817	32	86		
1/ 4	54.6901	133.302	32	85		
1/ 5	64.5231	143.339	32	88		
1/ 6	59.7671	142.827	32	85		
1/ 7	65.2101	151.104	32	85		
1/ 8	56.5461	136.217	32	85		
1/ 9	63.3001	148.984	32	85		
1/10	61.6411	147.096	32	86		
1/11	61.1751	144.124	32	85		
1/12	59.7871	143.461	32	85		
1/13	62.3241	147.681	32	85		
1/14	54.9871	135.423	32	85		
1/15	63.6721	147.011	32	85	A 60.32	143.16
1/16	58.4081	138.903	32	86	0 3.14	5.03
2/ 1	48.2741	230.109	35	170		
2/ 2	48.3811	258.185	35	170		
2/ 3	54.2171	245.625	35	170		
2/ 4	57.0231	261.509	35	170		
2/ 5	55.6321	240.866	35	170		
2/ 6	71.0191	267.260	35	170		
2/ 7	56.4261	241.585	35	170		
2/ 8	66.7841	226.299	35	170		
2/ 9	58.9191	243.915	35	170		
2/10	74.5551	249.639	35	170		
2/11	62.1961	223.926	35	170		
2/12	76.3751	210.916	35	170		
2/13	54.6991	212.340	35	170	A 59.74	234.87
2/14	62.4221	239.335	35	170		
2/15	58.3751	203.709	35	170	0 8.93	20.62
2/16	48.6211	194.784	35	170		
3/ 1	43.1261	213.808	26	143		
3/ 2	49.2991	239.205	26	143		
3/ 3	42.4011	201.831	26	143		
3/ 4	43.2351	212.961	26	143		
3/ 5	43.6991	203.188	26	143		
3/ 6	45.1081	213.653	26	143		
3/ 7	45.1741	238.690	26	143		
3/ 8	52.0151	215.031	26	143		
3/ 9	41.0901	208.138	26	143		
3/10	49.0291	212.120	26	143		
3/11	47.8331	221.933	26	143		
3/12	48.4491	210.429	26	143		
3/13	44.7231	205.893	26	143		
3/14	51.0271	221.417	26	143	46.25	215.09
3/15	46.7581	201.215	26	143	3.14	11.41
3/16	[illegible]	[illegible]	26	143		

SIGNAL

NOISE

BAND/ CHANNEL	CALCULATED VALUES LOW	CALCULATED VALUES HIGH	CALCULATED VALUES LOW	CALCULATED VALUES HIGH
1/ 1	69.9921	243.777	1.1701	1.7091
1/ 2	69.3541	242.501	1.1471	1.6651
1/ 3	70.1081	245.369	1.1701	1.7181
1/ 4	69.1131	241.874	1.2641	1.8141
1/ 5	70.2591	246.197	1.0891	1.7181
1/ 6	69.1071	241.567	1.1561	1.6911
1/ 7	69.8811	244.882	1.0721	1.6211
1/ 8	69.4211	242.575	1.2281	1.7811
1/ 9	69.7621	242.945	1.0941	1.6311
1/10	69.6261	243.920	1.1301	1.6581
1/11	69.5911	244.310	1.1381	1.6951
1/12	69.5691	243.871	1.1641	1.7001
1/13	69.3861	243.199	1.1131	1.6471
1/14	69.0061	241.403	1.2551	1.7831
1/15	69.2301	242.851	1.0871	1.6521
1/16	69.5701	243.659	1.1911	1.7531
2/ 1	27.2991	244.229	0.5961	1.0611
2/ 2	26.5401	242.430	0.5491	0.9391
2/ 3	26.7401	242.445	0.4931	0.9871
2/ 4	26.4841	241.937	0.4641	0.9251
2/ 5	26.4631	242.318	0.4761	1.0061
2/ 6	26.6451	241.700	0.3751	0.9041
2/ 7	26.4471	241.919	0.4691	1.0011
2/ 8	26.8431	244.671	0.3901	1.0811
2/ 9	26.5131	241.415	0.4501	0.9901
2/10	26.6551	243.001	0.3581	0.9731
2/11	26.8641	243.836	0.4321	1.0691
2/12	26.7591	244.666	0.3501	1.1181
2/13	26.6041	243.062	0.4861	1.1451
2/14	26.5221	242.032	0.4251	1.0111
2/15	26.7531	244.320	0.4581	1.1991
2/16	26.2831	240.461	0.5411	1.2341
3/ 1	26.6491	242.185	0.5951	1.1331
3/ 2	25.4311	244.529	0.5161	1.0221
3/ 3	25.2221	242.073	0.5951	1.1991
3/ 4	25.1321	243.377	0.5811	1.1431
3/ 5	25.0751	241.302	0.5741	1.1881
3/ 6	24.8871	240.328	0.5621	1.1251
3/ 7	24.8151	238.516	0.6501	0.9991
3/ 8	25.1451	242.378	0.4831	1.1271
3/ 9	25.0401	239.589	0.6091	1.1511
3/10	25.1041	242.078	0.5121	1.1411
3/11	24.9501	239.567	0.5221	1.0791
3/12	25.1741	241.088	0.5201	1.1561
3/13	24.9441	240.559	0.5681	1.1681
3/14	25.2151	243.219	0.4941	1.0281
3/15	25.1111	242.001	0.5171	1.2031
3/16	25.3211	244.028	0.5191	1.0991

INDEX C
SIGNAL TO NOISE RATIO

(cls), and noise (cls) at the radiance levels. (Cont.)

BAND/ CHANNEL	CALCULATED VALUES LOW	CALCULATED VALUES HIGH	SPEC VALUES LOW	SPEC VALUES HIGH	CHANNELS OUT OF SPEC LOW	CHANNELS OUT OF SPEC HIGH
4/ 1	45.089	354.771	32	240		
4/ 2	45.858	292.800	32	240		
4/ 3	42.364	280.567	32	240		
4/ 4	59.749	278.666	32	240		
4/ 5	52.865	277.687	32	240		
4/ 6	47.231	301.167	32	240		
4/ 7	41.741	275.422	32	240		
4/ 8	41.271	321.824	32	240		
4/ 9	51.735	321.058	32	240	A 46.21	298.74
4/10	38.515	345.690	32	240	D 5.6	25.15
4/11	41.754	287.109	32	240		
4/12	50.702	284.002	32	240		
4/13	50.761	277.685	32	240		
4/14	44.107	291.752	32	240		
4/15	47.485	278.749	32	240		
4/16	39.076	304.905	32	240		
5/ 1	39.183	189.483	13	75		
5/ 2	39.962	187.925	13	75		
5/ 3	35.344	171.395	13	75		
5/ 4	35.021	171.119	13	75		
5/ 5	37.005	178.453	13	75		
5/ 6	38.772	181.017	13	75		
5/ 7	25.381	145.860	13	75		
5/ 8	37.821	180.569	13	75		
5/ 9	36.224	173.275	13	75		
5/10	29.854	163.497	13	75	35.83, 176.40	
5/11	30.541	180.094	13	75		
5/12	33.001	169.719	13	75	3.92, 11.71	
5/13	35.900	172.849	13	75		
5/14	37.027	182.958	13	75		
5/15	37.313	178.996	13	75		
5/16	30.108	182.679	13	75		
7/ 1	31.240	182.865	5	45		
7/ 2	28.356	181.367	5	45		
7/ 3	29.813	182.927	5	45		
7/ 4	28.533	181.172	5	45		
7/ 5	31.670	189.415	5	45		
7/ 6	27.624	177.119	5	45		
7/ 7	29.780	178.736	5	45		
7/ 8	25.436	170.458	5	45		
7/ 9	28.040	181.500	5	45		
7/10	25.934	171.297	5	45		
7/11	27.755	179.290	5	45	A 28.28, 180.55	
7/12	25.318	174.796	5	45	D 1.95	5.98
7/13	29.812	189.124	5	45		
7/14	26.129	174.330	5	45		
7/15	29.418	185.060	5	45		
7/16	27.646	189.317	5	45		

BAND/ CHANNEL	SIGNAL CALCULATED VALUES LOW	SIGNAL CALCULATED VALUES HIGH	NOISE CALCULATED VALUES LOW	NOISE CALCULATED VALUES HIGH
4/ 1	17.877	241.408	0.396	0.600
4/ 2	17.014	239.531	0.371	0.818
4/ 3	17.289	238.174	0.408	0.849
4/ 4	16.848	236.624	0.287	0.849
4/ 5	17.039	239.039	0.322	0.861
4/ 6	17.521	241.913	0.371	0.799
4/ 7	17.545	239.305	0.420	0.869
4/ 8	17.240	240.774	0.418	0.749
4/ 9	17.060	236.729	0.330	0.737
4/10	17.145	241.366	0.445	0.699
4/11	17.295	239.269	0.414	0.833
4/12	16.960	238.615	0.333	0.849
4/13	17.008	238.526	0.335	0.859
4/14	17.140	239.216	0.389	0.820
4/15	17.060	238.242	0.359	0.855
4/16	17.140	240.090	0.439	0.787
5/ 1	34.714	240.653	0.876	1.270
5/ 2	34.096	237.787	0.853	1.265
5/ 3	34.274	239.080	0.970	1.395
5/ 4	34.154	238.067	0.975	1.391
5/ 5	34.229	239.259	0.925	1.341
5/ 6	34.318	239.370	0.866	1.327
5/ 7	33.992	237.424	1.539	1.654
5/ 8	34.851	242.090	0.921	1.284
5/ 9	34.290	239.318	0.947	1.301
5/10	34.701	241.428	1.203	1.477
5/11	34.499	241.098	0.895	1.287
5/12	34.509	240.876	1.046	1.419
5/13	34.253	239.369	0.954	1.305
5/14	34.273	238.353	0.976	1.309
5/15	34.212	239.201	0.917	1.338
5/16	34.486	240.382	0.900	1.316
7/ 1	29.159	235.394	0.908	1.287
7/ 2	27.541	232.932	0.971	1.284
7/ 3	27.810	234.079	0.933	1.296
7/ 4	27.675	233.971	0.970	1.292
7/ 5	27.900	236.464	0.881	1.248
7/ 6	27.589	233.073	0.999	1.316
7/ 7	27.756	235.461	0.932	1.317
7/ 8	27.813	234.914	1.073	1.378
7/ 9	27.673	234.626	0.985	1.293
7/10	27.669	234.321	1.071	1.367
7/11	27.893	236.475	1.005	1.319
7/12	27.690	235.372	1.094	1.347
7/13	27.375	233.116	0.918	1.233
7/14	27.894	235.440	1.060	1.351
7/15	27.653	235.018	0.940	1.270
7/16	27.763	234.548	1.004	1.319

OF POOR QUALITY

FLIGHT MODEL
TYPICAL GAIN LINEARITY

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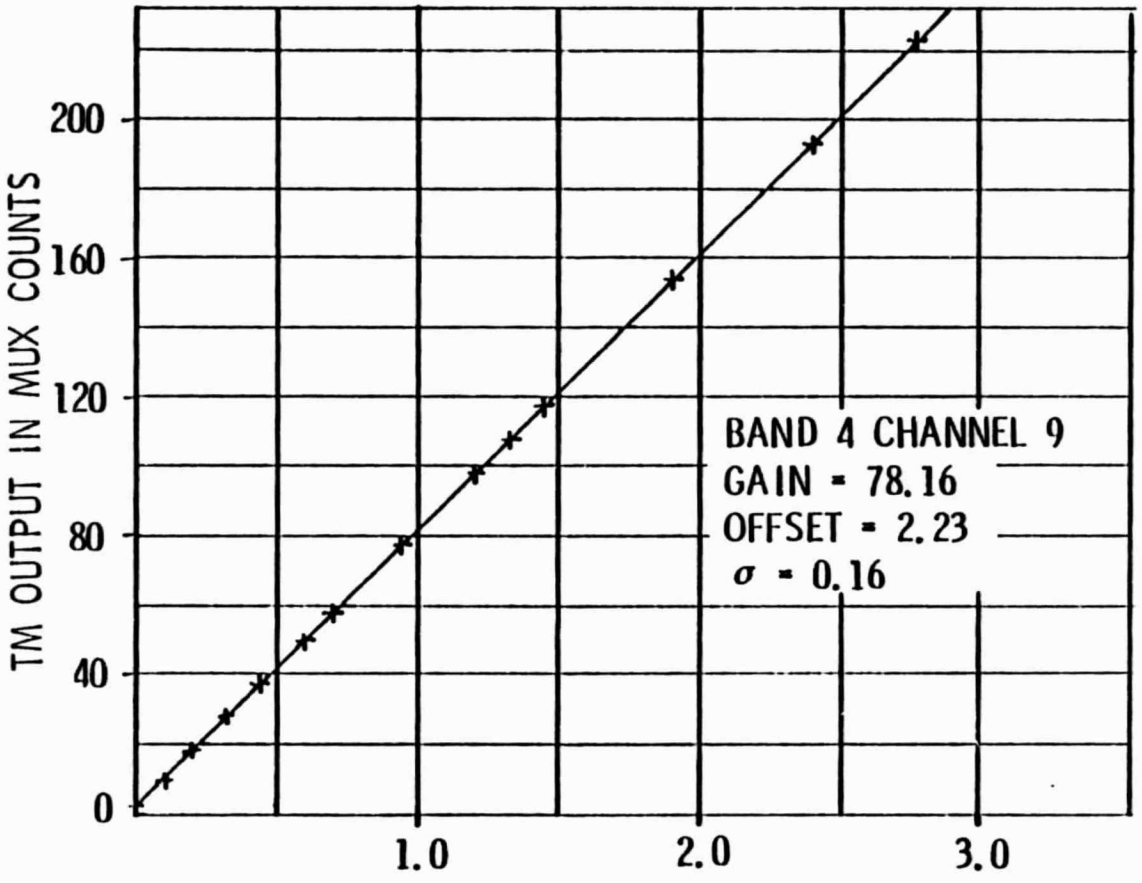

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FLIGHT MODEL
TYPICAL GAIN LINEARITY

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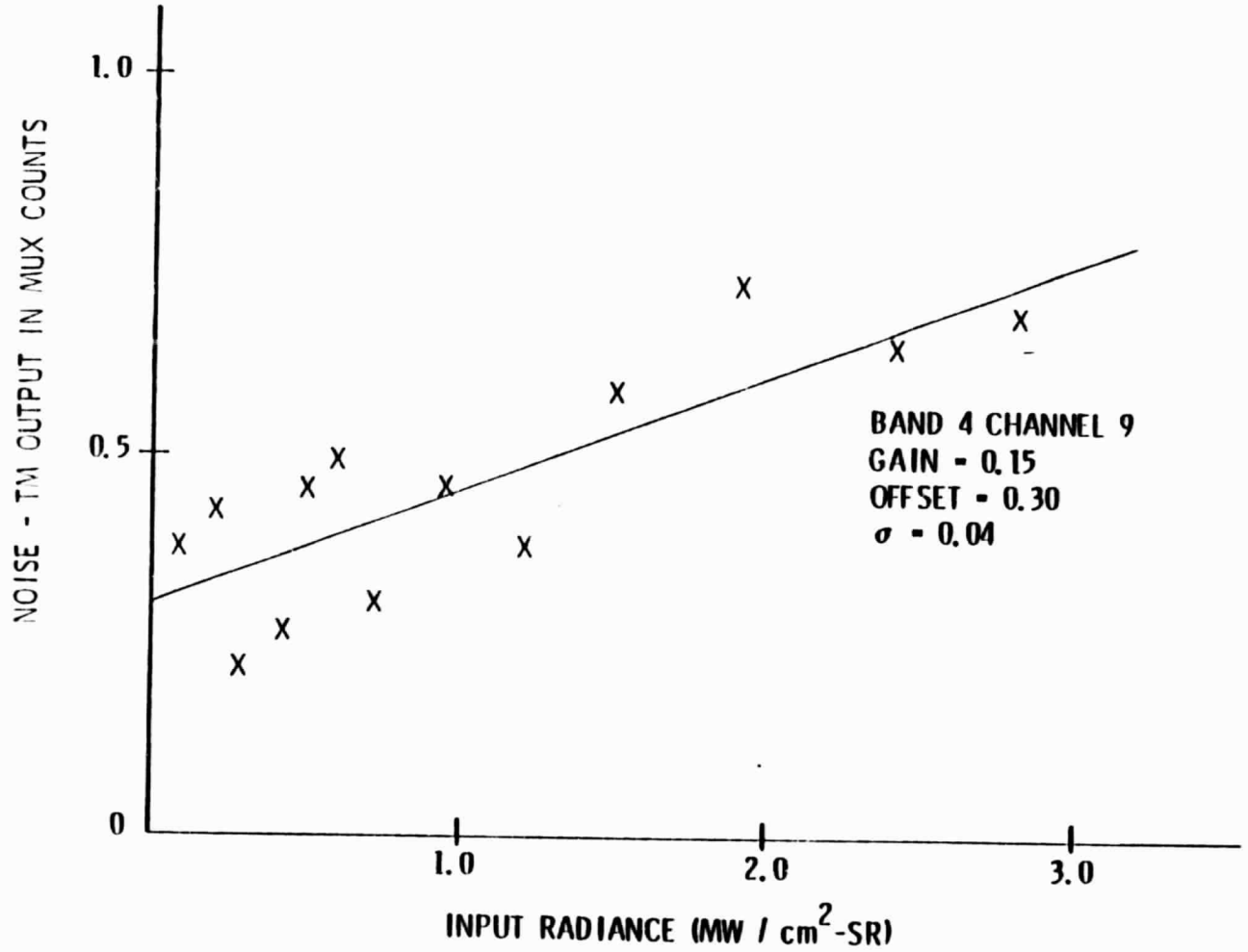

RADIOMETRIC SENSITIVITY
THERMAL VACUUM 9/7/82

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CHANNEL	BAND 1		BAND 2		BAND 3		BAND 4		BAND 5		BAND 7	
No.	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2	S_1	S_2
1	50.6	125.9	39.5	218.7	41.2	189.5	39.3	221.9	39.1	143.0	13.0	129.3
2	47.3	115.5	46.2	201.9	52.6	217.3	34.8	265.8	38.4	136.9	27.5	132.4
3	50.7	121.7	49.0	195.7	40.5	183.1	35.0	267.0	32.6	128.6	27.5	139.3
4	49.1	120.1	58.8	194.8	45.3	184.0	40.8	222.4	28.2	112.9	26.6	129.7
5	56.4	127.9	43.9	233.5	37.9	189.0	45.8	258.8	36.0	131.9	28.1	157.6
6	48.3	121.0	64.0	223.8	42.3	183.5	34.3	253.6	37.5	131.2	26.1	133.1
7	56.5	128.9	45.6	187.0	41.8	192.0	43.9	251.0	18.0	91.4	25.8	139.1
8	48.1	119.9	60.5	226.2	52.2	225.4	37.6	214.0	37.0	132.2	23.1	121.3
9	58.9	131.4	52.7	220.8	39.0	185.2	58.9	211.9	31.7	127.8	26.2	150.3
10	55.5	126.5	66.4	243.3	44.4	220.1	37.1	229.8	11.2	67.6	22.4	123.0
11	55.7	128.7	57.4	202.1	43.9	190.9	38.8	253.4	36.4	130.1	26.4	157.0
12	57.2	125.9	70.6	232.7	32.0	115.3	43.4	170.6	28.4	110.0	23.6	138.2
13	56.6	130.3	47.6	197.7	44.7	156.3	51.3	229.2	34.3	95.8	28.7	157.1
14	51.2	115.7	51.5	206.3	49.4	223.74	33.9	256.6	36.9	124.6	25.8	138.3
15	54.1	116.5	46.9	229.7	42.4	210.4	43.4	243.0	37.1	129.6	27.8	160.4
16	54.4	123.2	36.2	218.1	47.3	205.3	33.2	239.4	36.4	133.5	27.9	140.2
AVG	53.7	123.7	52.3	214.5	43.7	191.9	40.7	236.8	32.5	120.5	25.3	140.4
				16.8					33.9	124.9 W/O 10		
	3.7	5.2	9.8		5.2	27.7	7.0	25.2	7.8	20.1	3.7	12.6
									5.5	14.9 W/O 10		

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FLIGHT MODEL GAINS AND OFFSETS

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GAINS

COUNTS / (MW/cm^2-sr-μm)

CH	BAND 1	BAND 2	BAND 3	BAND 4	BAND 5	BAND 7
1	16.90	8.30	10.65	11.13	79.07	145.60
2	16.84	8.26	10.77	11.08	78.19	144.45
3	17.05	8.25	10.66	11.00	78.65	145.65
4	16.81	8.24	10.73	10.95	78.27	145.08
5	17.11	8.26	10.63	11.06	78.72	146.69
6	16.78	8.23	10.59	11.27	78.70	144.52
7	17.02	8.25	10.51	11.03	78.11	146.09
8	16.84	8.33	10.68	11.13	79.54	145.67
9	16.89	8.22	10.55	10.94	78.72	145.61
10	16.95	8.28	10.67	11.17	79.34	145.35
11	16.99	8.30	10.55	11.05	79.32	146.71
12	16.95	8.34	10.71	11.04	79.22	146.08
13	16.91	8.28	10.60	11.03	79.76	144.73
14	16.77	8.25	10.72	11.06	78.33	145.97
15	16.89	8.32	10.66	11.02	78.73	145.85
16	16.92	8.20	10.75	11.11	79.02	145.43
AVERAGE	16.92	8.28	10.66	11.07	78.73	145.60
σ	0.09	0.04	0.08	0.08	0.47	0.67
P-P RANGE (%)	2.1	1.2	2.5	2.1	1.8	1.6

FLIGHT MODEL GAINS AND OFFSETS CONT.

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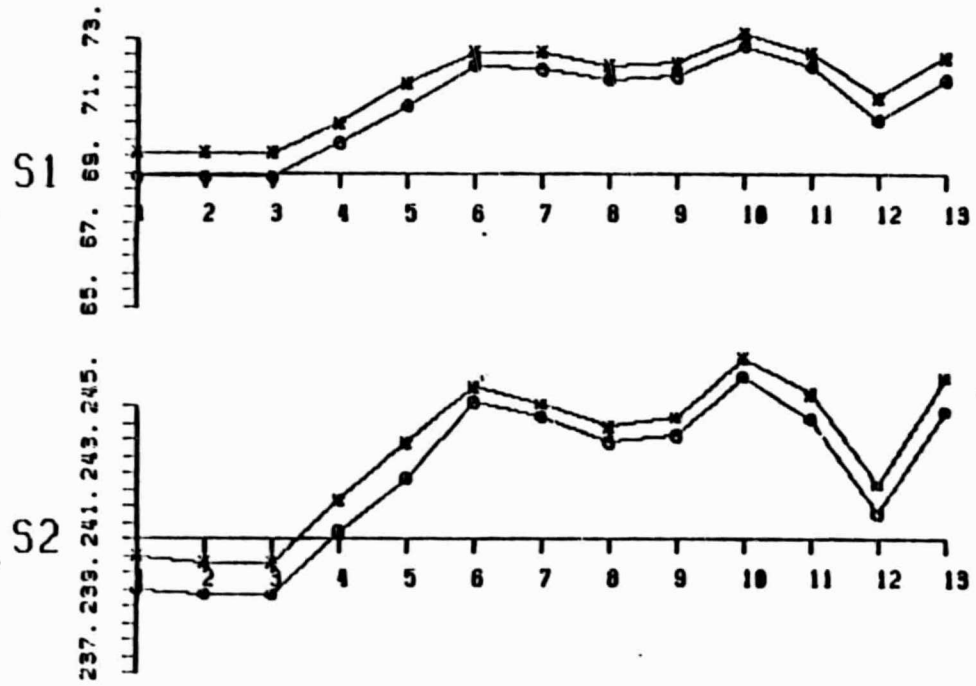
	CH	BAND 1	BAND 2	BAND 3	BAND 4	BAND 5	BAND 7
OFFSETS (COUNTS)	1	2.3611	2.3642	2.5291	2.7296	3.2741	3.7249
	2	1.9696	1.7276	2.0640	1.9443	3.0327	3.0994
	3	1.8903	1.9534	2.0706	2.3745	2.9877	3.1522
	4	1.8683	1.7034	1.8335	1.9773	3.0701	3.1319
	5	1.7870	1.6286	2.0013	2.0315	2.9358	3.0771
	6	1.9857	1.9431	1.8939	2.2553	3.0896	3.1341
	7	1.7765	1.6620	2.0094	2.6539	2.9341	3.0318
	8	2.0248	1.8121	1.9625	2.1356	3.2646	3.1544
	9	1.6703	1.8053	2.1497	2.2266	3.0019	2.9691
	10	1.7897	1.7908	1.9559	1.9655	3.2023	3.0615
	11	1.5947	1.9276	2.0539	2.3155	2.9620	3.0575
	12	1.7278	1.7046	1.9210	1.9610	3.0430	2.9621
	13	1.7458	1.7081	1.9415	2.0231	2.9406	2.8572
	14	1.9115	1.7411	1.9533	2.1192	3.1673	3.1948
	15	1.6611	1.7416	1.9716	2.1018	2.9183	2.9619
	16	1.8567	1.6448	1.9773	2.0190	3.1127	3.1552



X-AXIS LEGEND

1 •BL07 MTF 7/25/82 18:54:35	4 •SAT MTF 8/ 5/82 2:19:20	7 •SAT MTF 9/ 7/82 9: 4:47	10 •SAT MTF 9/ 7/82 14:46:33	13 •SAT MTF 9/13/82 10:36:26
2 •BL07 MTF 7/29/82 18:45:32	5 •SAT MTF 8/22/82 20:22:26	8 •SAT MTF 9/ 7/82 11:30:11	11 •SAT MTF 9/ 7/82 18:12:19	
3 •SAT MTF 7/29/82 18:45:32	6 •SAT MTF 9/ 4/82 13:31: 6	9 •SAT MTF 9/ 7/82 13: 8:28	12 •SAT MTF 9/11/82 15:31:34	

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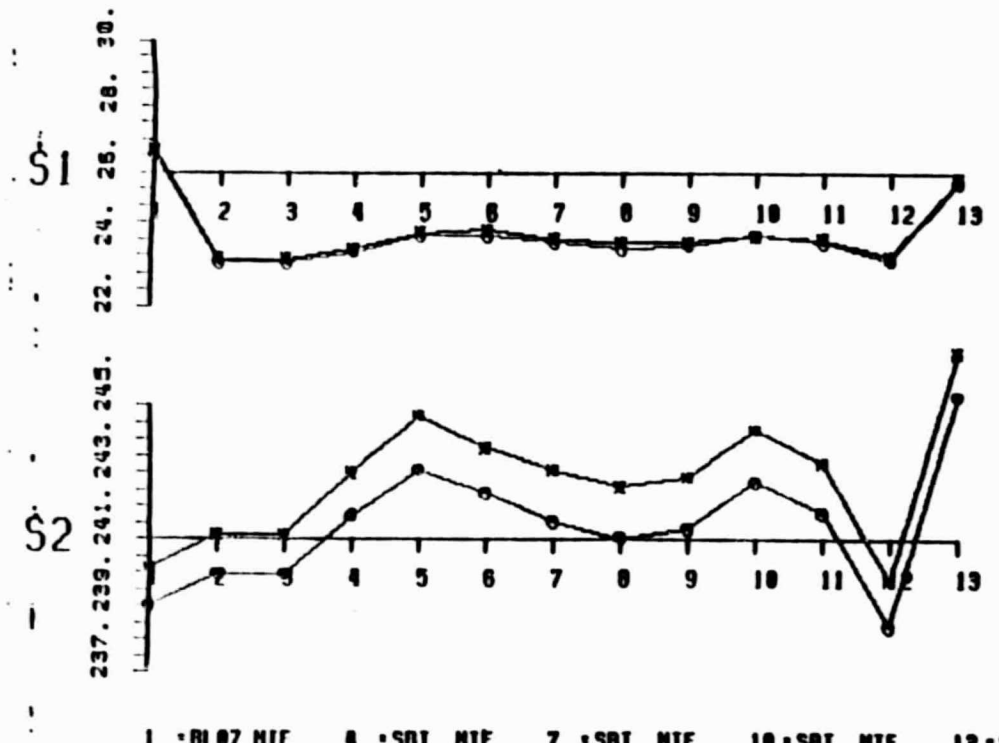
A SUBSIDIARY OF [illegible]

RADIOMETRIC STABILITY BAND 1 CH 9 & 10

9/82



X-AXIS LEGEND

1	BL07 MTF 7/25/82 18:54:35	4	SAT MTF 8/ 5/82 2:19:20	7	SAT MTF 9/ 7/82 3: 4:47	10	SAT MTF 9/ 7/82 14:46:33	13	SAT MTF 9/13/82 10:36:26				
2	BL07 MTF 7/29/82 18:45:32	5	SAT MTF 8/22/82 20:22:26	8	SAT MTF 9/ 7/82 11:30:11	11	SAT MTF 9/ 7/82 18:12:19						
3	SAT MTF 7/29/82 18:45:32	6	SAT MTF 9/ 4/82 13:31: 6	9	SAT MTF 9/ 7/82 13: 8:28	12	SAT MTF 9/11/82 15:31:34						

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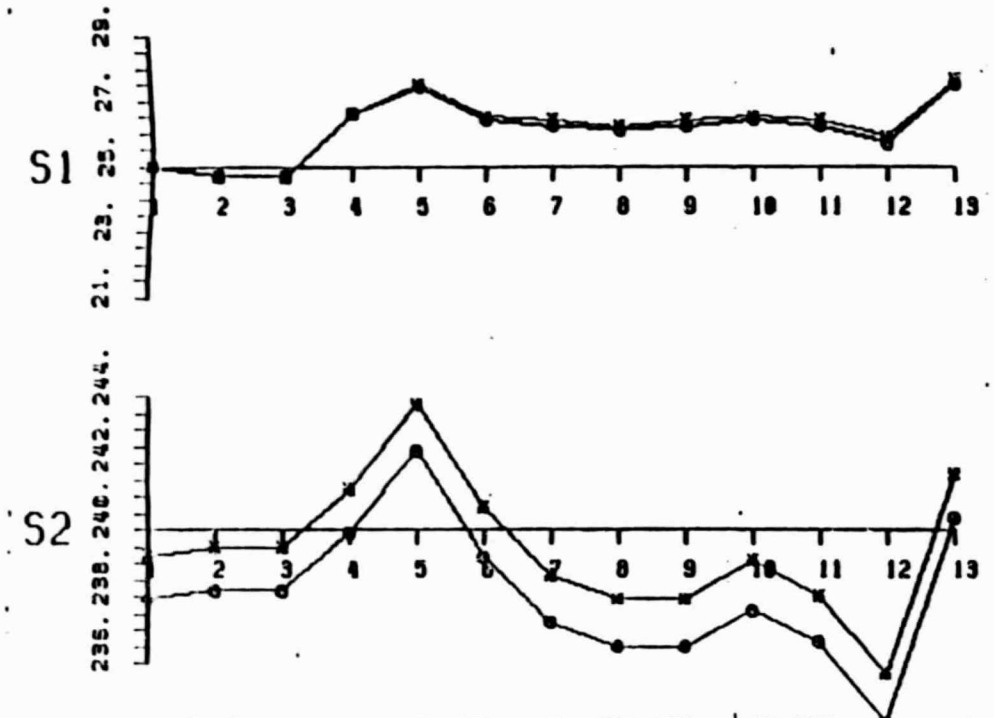
RADIOMETRIC STABILITY BAND 2 CH 9 & 10

9/82



X-AXIS LEGEND

1 • BL07 MTF 7/25/82 18:54:35	4 • SAT MTF 8/ 5/82 2:19:20	7 • SAT MTF 9/ 7/82 3: 4:47	10 • SAT MTF 9/ 7/82 14:46:33	13 • SAT MTF 9/13/82 10:36:26
2 • BL07 MTF 7/29/82 18:45:32	5 • SAT MTF 8/22/82 20:22:26	8 • SAT MTF 9/ 7/82 11:30:11	11 • SAT MTF 9/ 7/82 18:12:19	
3 • SAT MTF 7/29/82 18:45:32	6 • SAT MTF 9/ 4/82 13:31: 6	9 • SAT MTF 9/ 7/82 13: 8:28	12 • SAT MTF 9/11/82 15:31:34	

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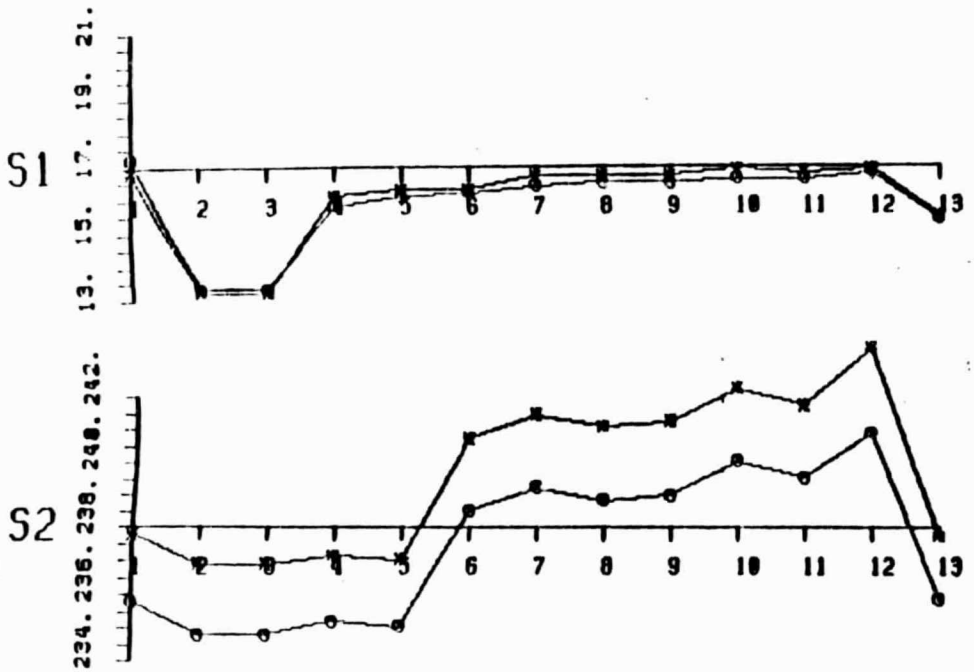
RADIOMETRIC STABILITY BAND 3 CH 9 & 10

9/82



X-AXIS LEGEND

1 = BL07 MTF 7/25/82 18:54:35	4 = SAT MTF 8/ 5/82 2:19:20	7 = SAT MTF 9/ 7/82 3: 4:47	10 = SAT MTF 9/ 7/82 14:46:33	13 = SAT MTF 9/13/82 10:36:26
2 = BL07 MTF 7/29/82 18:45:32	5 = SAT MTF 8/22/82 20:22:26	8 = SAT MTF 9/ 7/82 11:30:11	11 = SAT MTF 9/ 7/82 16:12:19	
3 = SAT MTF 7/29/82 18:45:32	6 = SAT MTF 9/ 4/82 13:31: 6	9 = SAT MTF 9/ 7/82 13: 8:28	12 = SAT MTF 9/11/82 15:31:34	

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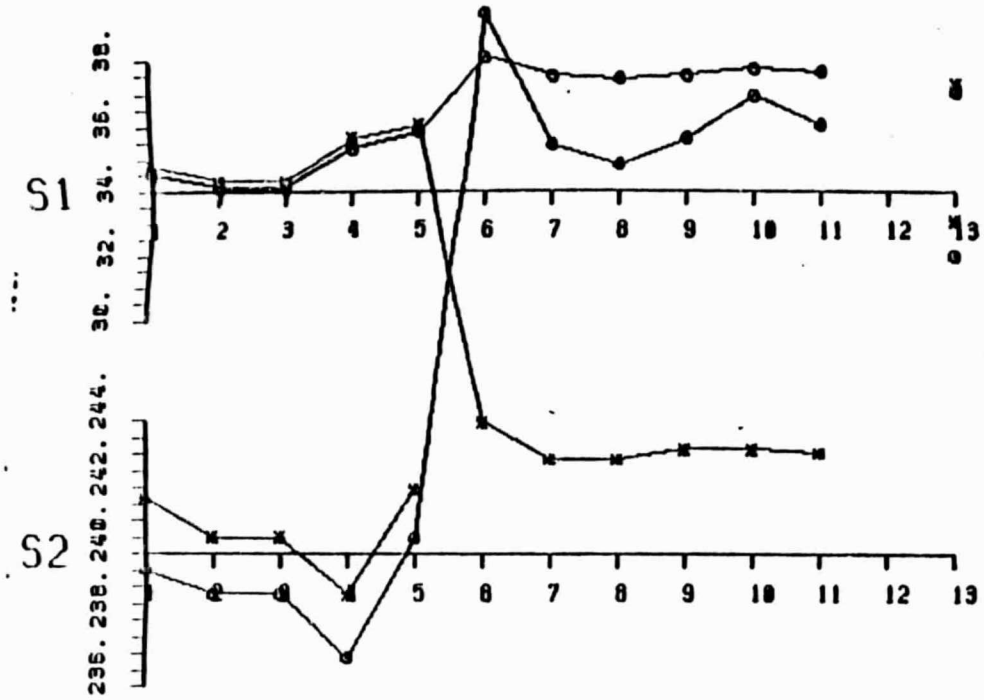
RADIOMETRIC STABILITY BAND 4 CH 9 & 10

9/82



	1	BL07 MTF 7/25/82 18:54:35	4	SAT MTF 8/ 5/82 2:19:20	7	SAT MTF 9/ 7/82 3: 4:47	10	SAT MTF 9/ 7/82 14:46:33	13	SAT MTF 9/13/82 10:36:26
X-AXIS LEGEND	2	BL07 MTF 7/29/82 18:45:32	5	SAT MTF 8/22/82 20:22:26	8	SAT MTF 9/ 7/82 11:30:11	11	SAT MTF 9/ 7/82 18:12:19		
	3	SAT MTF 7/29/82 18:45:32	6	SAT MTF 9/ 4/82 13:31: 6	9	SAT MTF 9/ 7/82 13: 8:28	12	SAT MTF 9/11/82 15:31:34		

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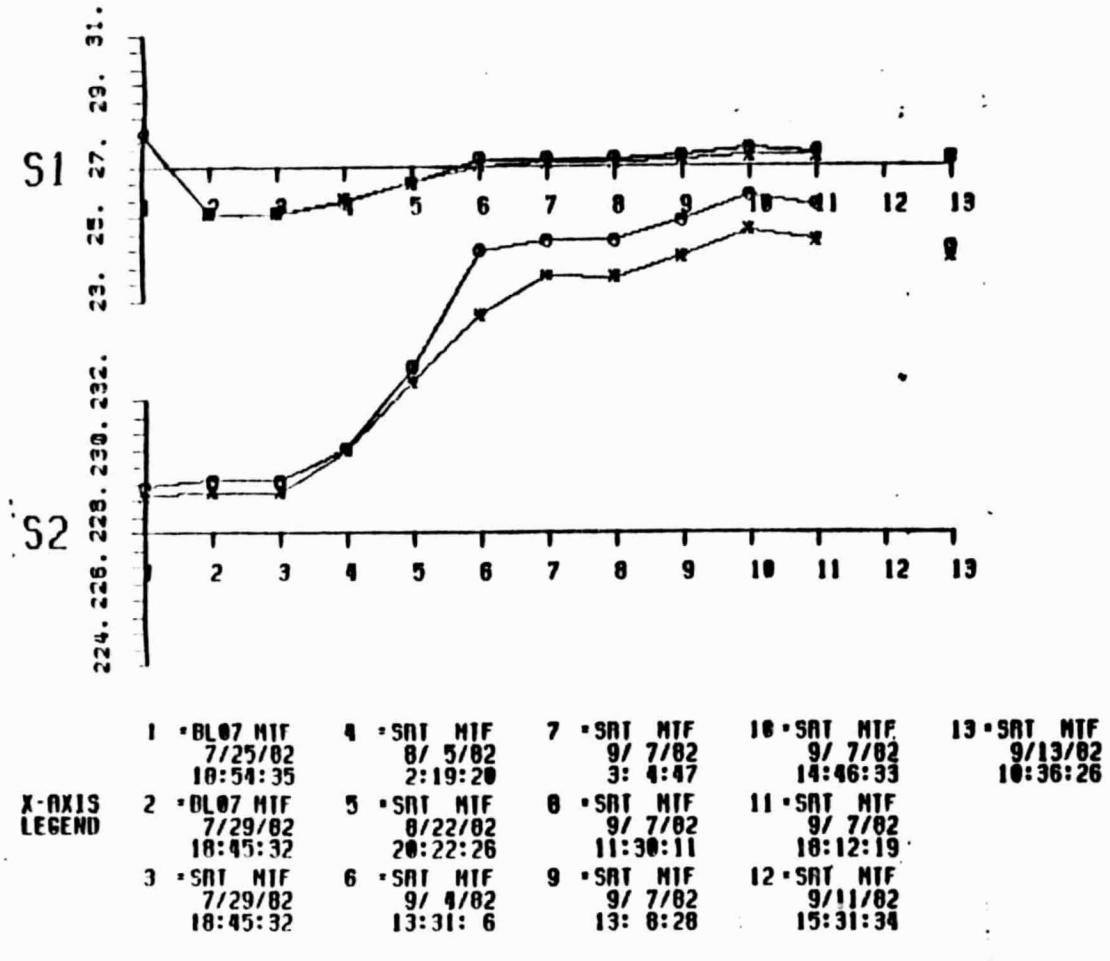
RADIOMETRIC STABILITY BAND 5 CH 9 & 10

9/82



X-AXIS LEGEND

1 • BL07 MTF 7/25/02 10:54:35	4 • SAT MTF 8/ 5/02 2:19:20	7 • SAT MTF 9/ 7/02 3: 4:47	10 • SAT MTF 9/ 7/02 14:46:33	13 • SAT MTF 9/13/02 10:36:26
2 • BL07 MTF 7/29/02 18:45:32	5 • SAT MTF 8/22/02 20:22:26	8 • SAT MTF 9/ 7/02 11:30:11	11 • SAT MTF 9/ 7/02 18:12:19	
3 • SAT MTF 7/29/02 18:45:32	6 • SAT MTF 9/ 4/02 13:31: 6	9 • SAT MTF 9/ 7/02 13: 8:28	12 • SAT MTF 9/11/02 15:31:34	

RADIOMETRIC STABILITY BAND 7 CH 9 & 10

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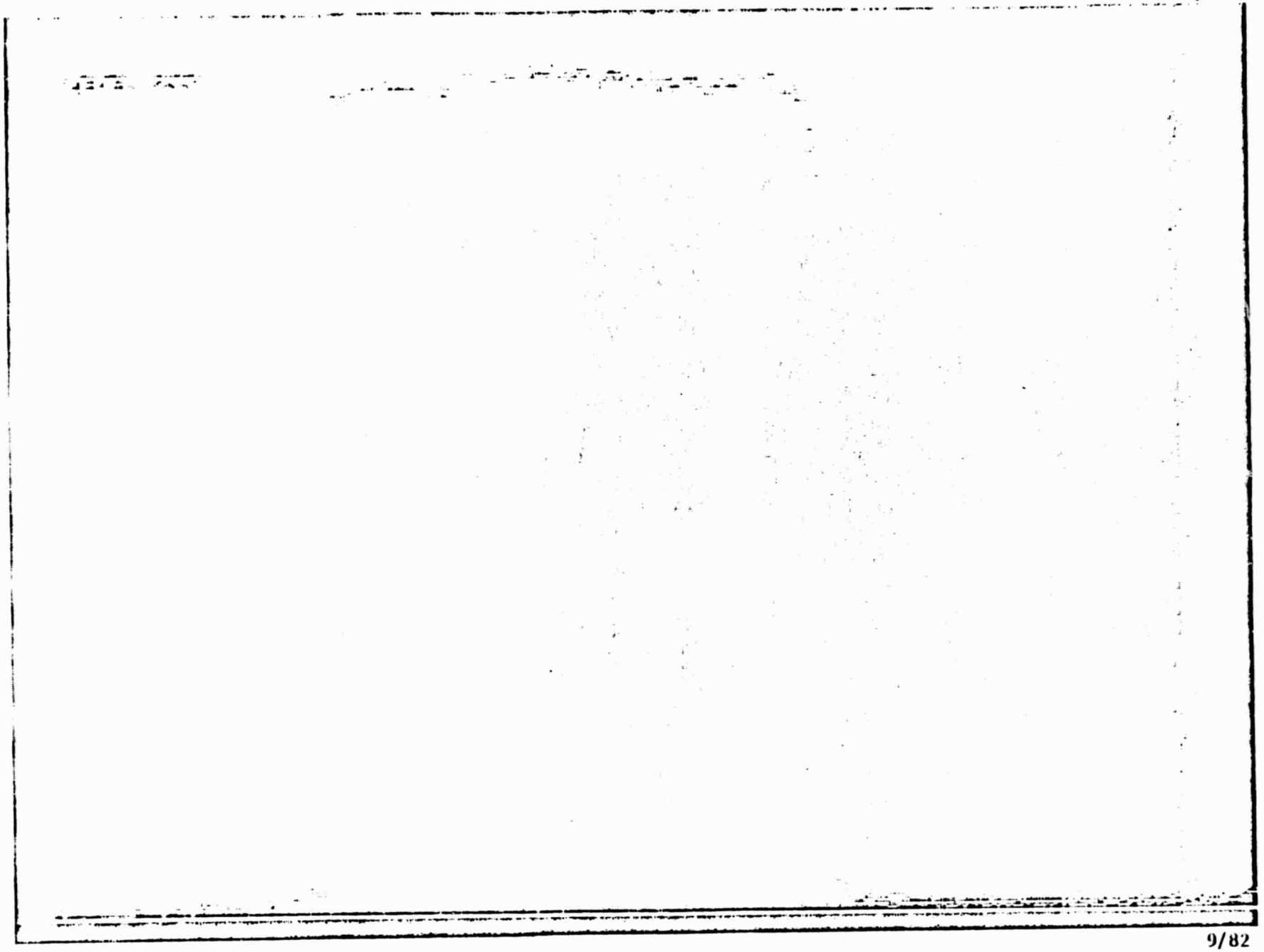
SIGNAL DRIFT BAND 1 CHANNEL 9

9/21/ 2

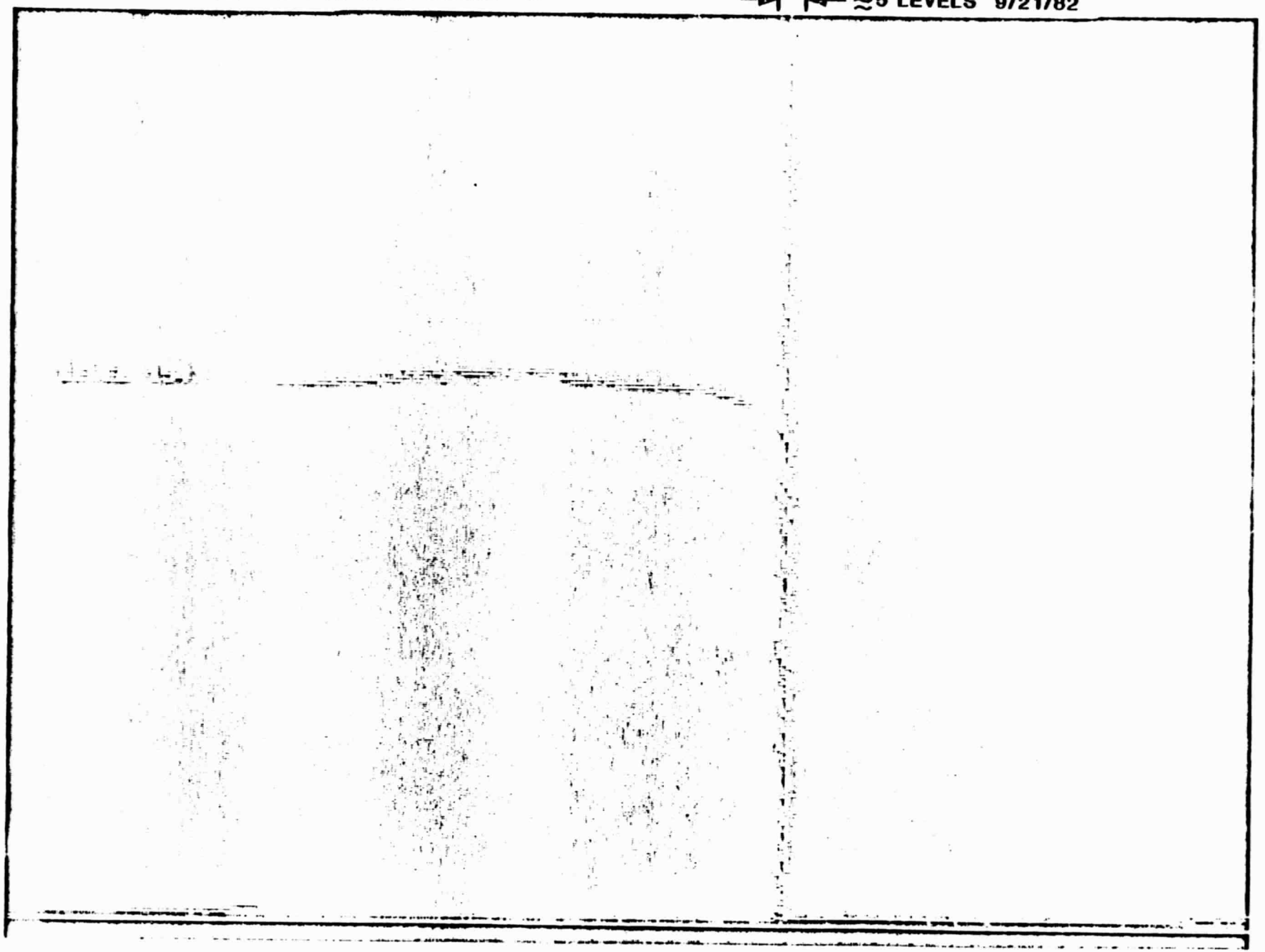
→| |← ≈10 LEVEL



9/82

BAND 1 DET 9 HDRT H03049 6500→7500′

SIGNAL DRIFT
BAND 2 CHANNEL 9

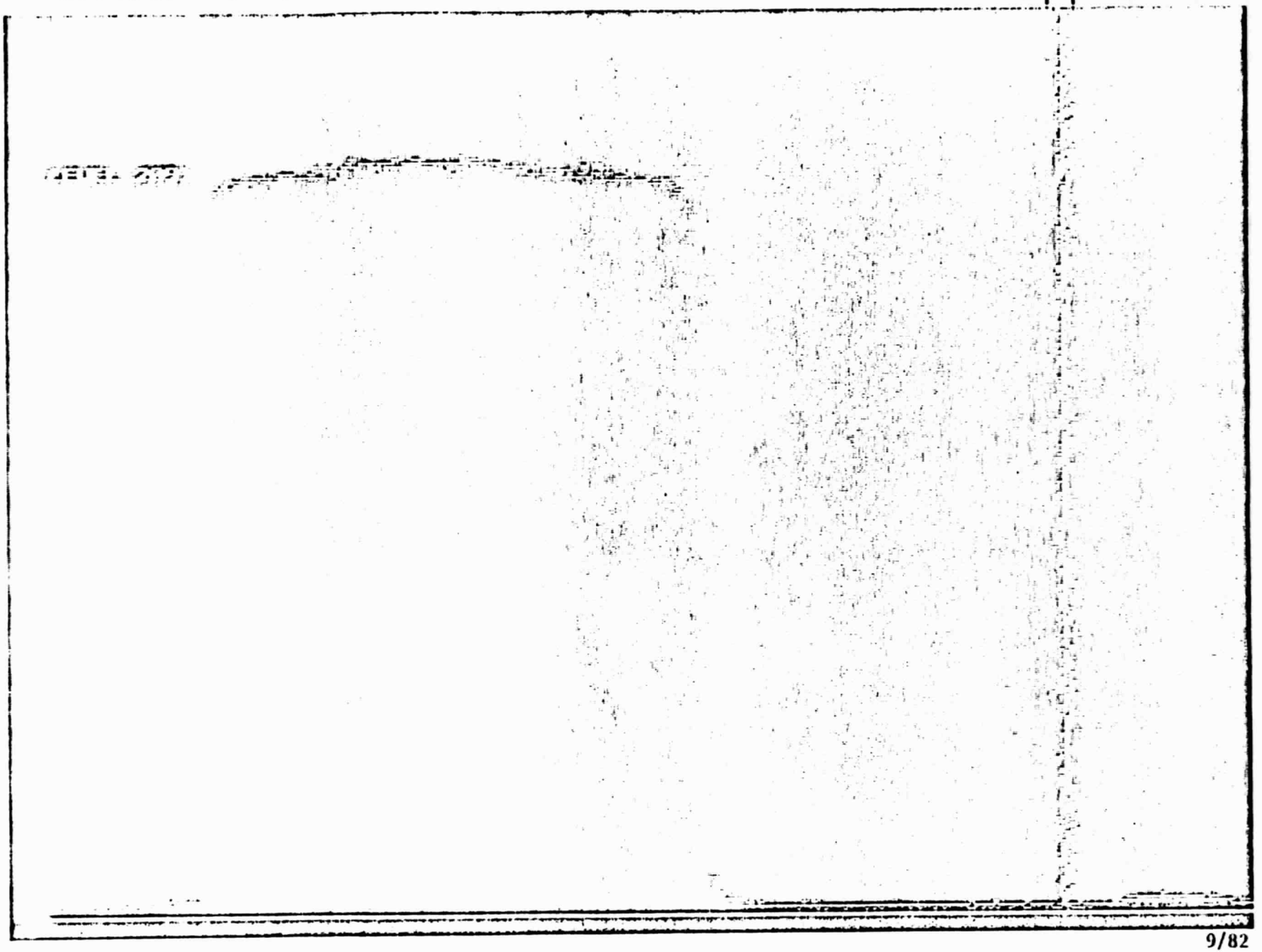


BAND 2 DET 9 HDRT H03049 7000→8000′

SIGNAL DRIFT
BAND 3 CHANNEL 9

9/21/82

≈6 LEVELS



9/82

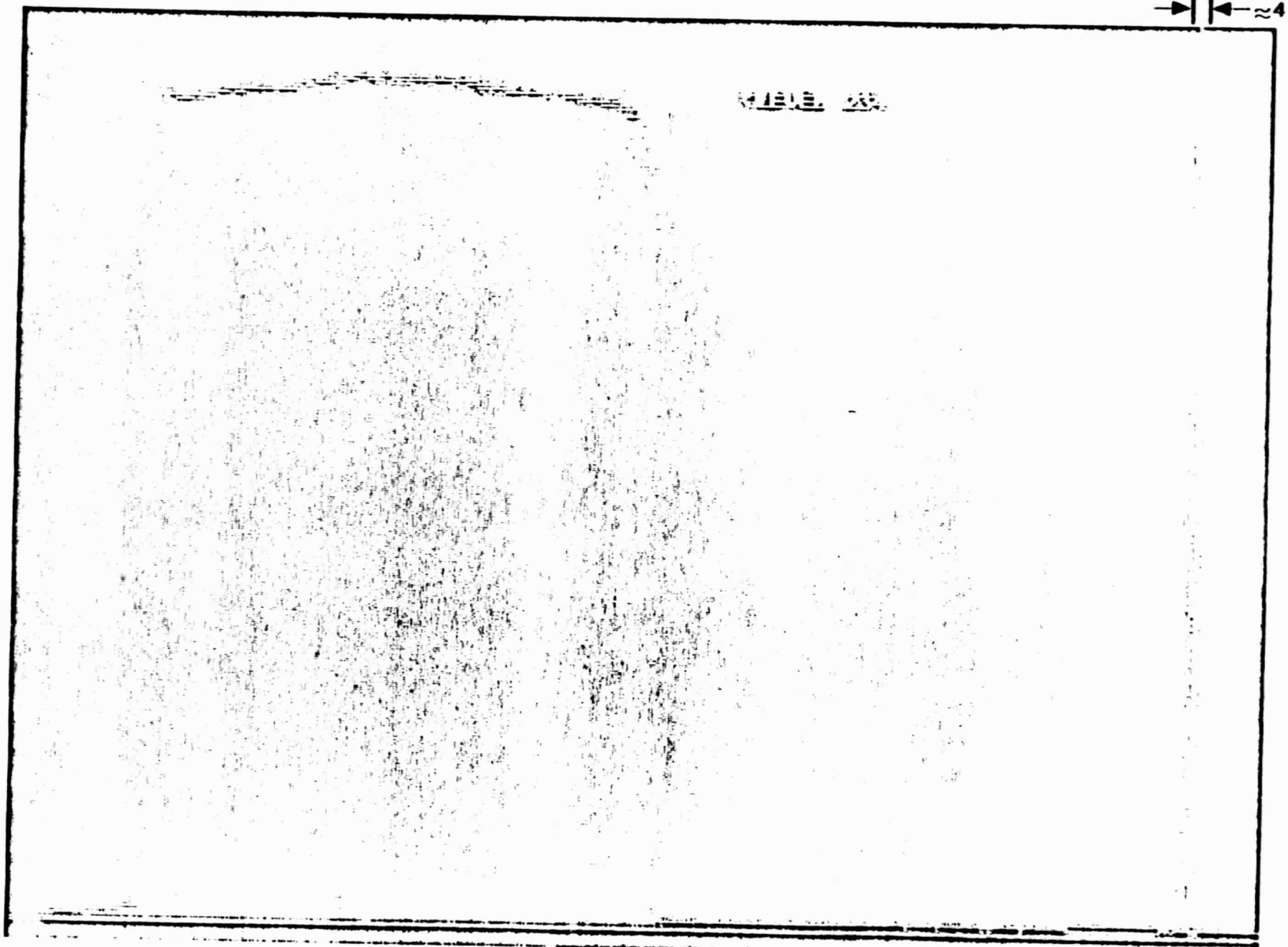
BAND 3 CHANNEL 9 HDRT H03049 7400→8400'

SIGNAL DRIFT

BAND 4 CHANNEL 9

9/21/82

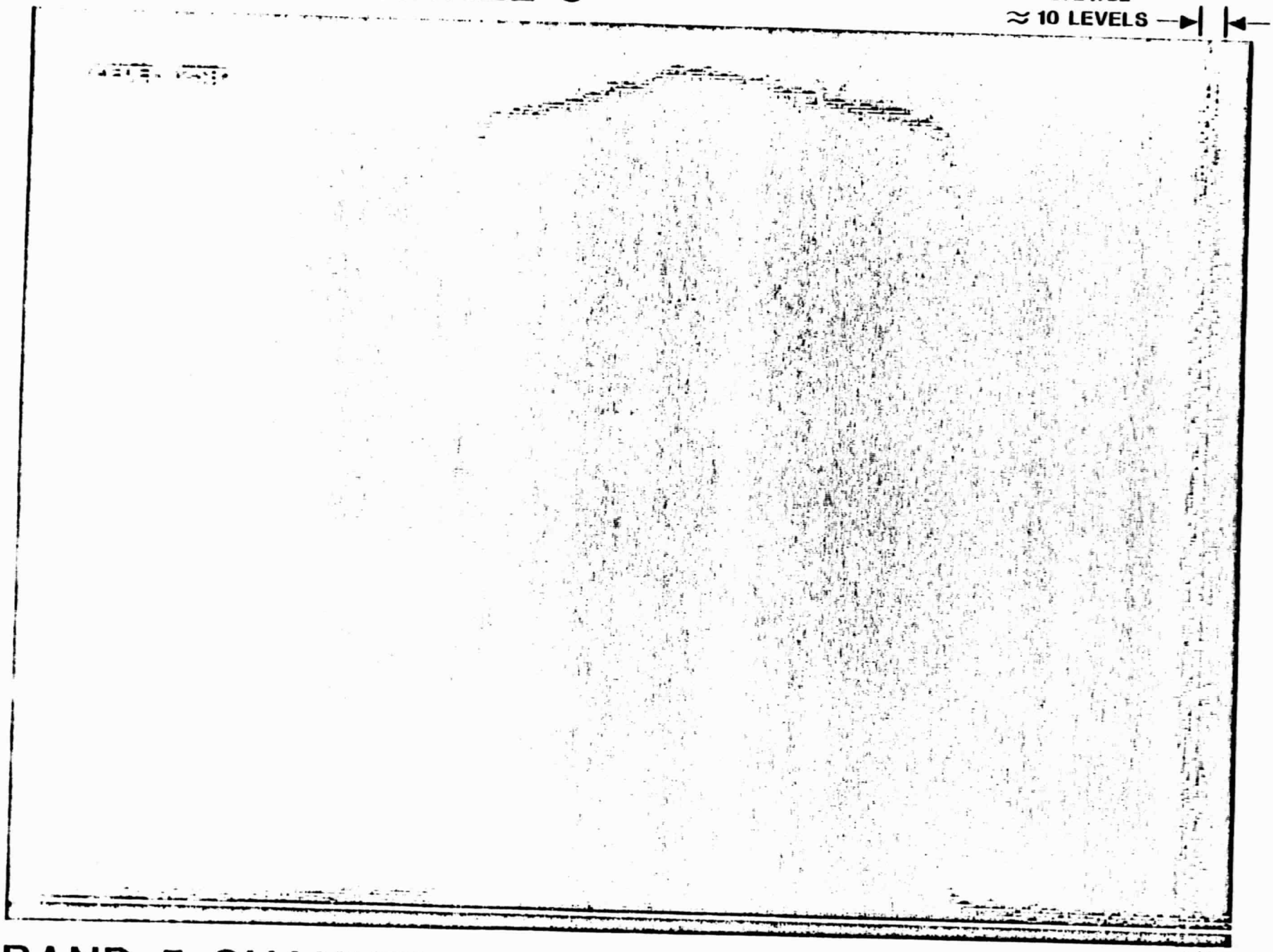
≈4 LEVELS



BAND 4 DET 9 HDRT H03049 7400→8100'

9/82

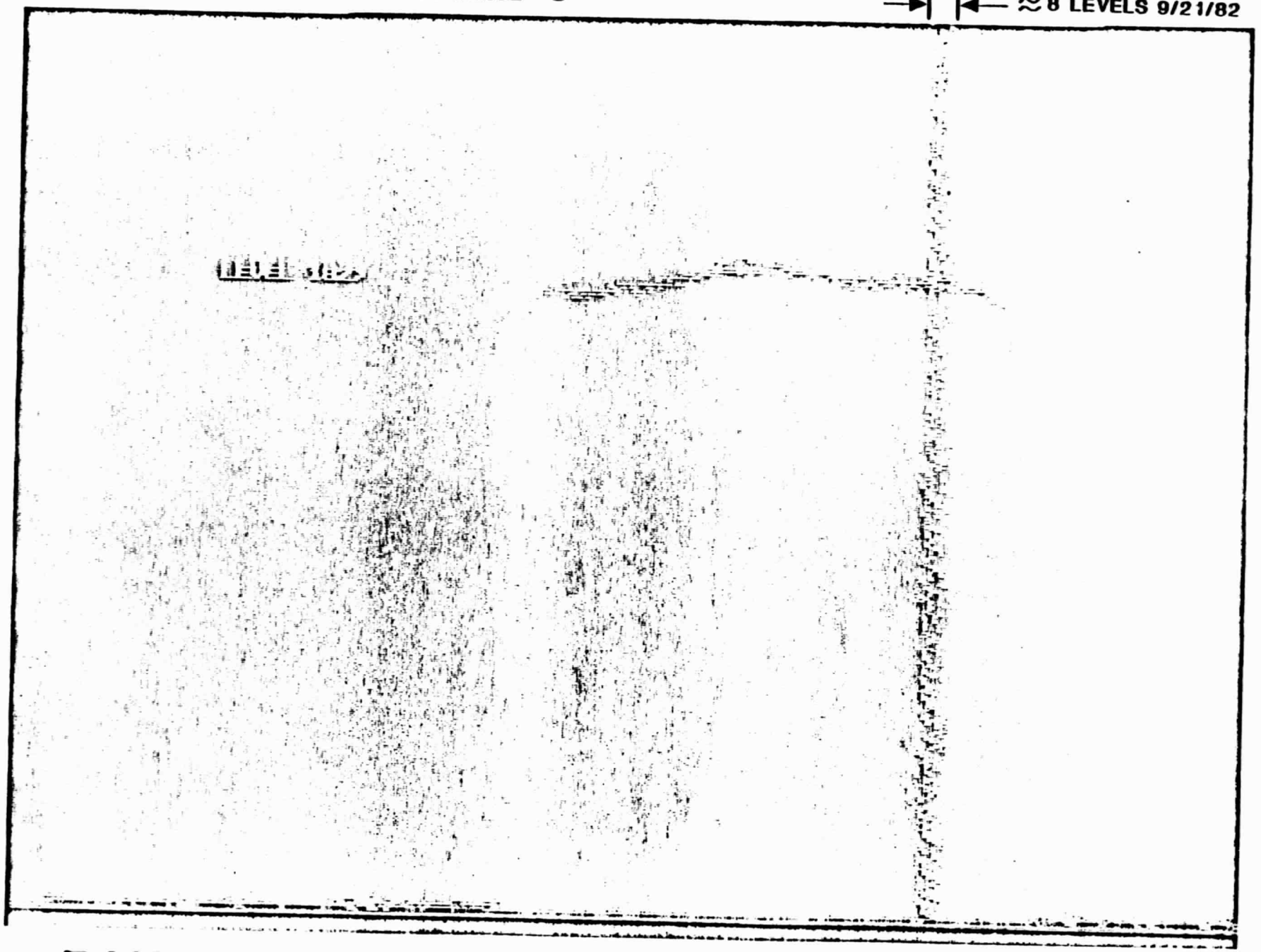
SIGNAL DRIFT
BAND 5 CHANNEL 9



BAND 5 CHANNEL 9 HDRT H03049 7400→8100′ 9/82

SIGNAL DRIFT

BAND 7 CHANNEL 9



BAND 7 DET 9 HDRT H03049 7400→8100'

STEP RESPONSE (3.2.9.2)
BANDS 1-5, 7
FLIGHT MODEL

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PARAMETER	SPECIFICATION	PERFORMANCE
OVERSHOOT	≤10%	≤10%; EXCEPT 7 CHANNELS OF BAND 5 ≤11.5% 3.5% TYP, BANDS 1-4 10.0% TYP, BANDS 5, 7
SETTLING TIMES	≤1.5% ERROR AFTER 30 μ sec	BAND 1 - 8 CHANNELS FAIL BAND 2 - 2 " " 3 - 11 " " 4 - 5 " " 5 - 1 " " 7 - NO " "
	≤1.0% ERROR AFTER 60 μ sec	BAND 1 - 3 CHANNELS FAIL ≤1% - 90 μS 2 - 7 " " ≤1% - 170 μS 3 - NO " " 4 - 1 " " ≤1% - 90 μS 5 - NO " " 7 - NO
RISETIME	≤20 μ sec	≤17 μ sec
DROOP	≤0.5%	NO DATA

9/82
21170 232

STEP RESPONSE BAND 6
FLIGHT MODEL (3.2.9.2)

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PARAMETER	SPECIFICATION	PERFORMANCE
OVERSHOOT	≤10%	≤3.8%
SETTLING TIMES	≤1.5% ERROR AFTER 120 μSEC	≤1.5% ERROR AFTER 35 μSEC
	≤1.0% ERROR AFTER 240 μSEC	≤1.0% ERROR AFTER 65 μSEC
RISETIME	≤80 μSEC	≤70 μSEC
DROOP	≤0.5%	NO DATA

FLIGHT MODEL
COHERENT NOISE

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BAND	CHANNEL	AMPLITUDE (PK MUX CNTS)	FREQUENCY (HZ)
1	2	0.31	9144
2	13	0.23	18492
3	5	0.26	9144
4	ALL	$\leq$0.10	>5 kHz *
5	7**	1.06	9144
7	10	0.29	9144

* AT FREQUENCIES LESS THAN 5 kHz THERE ARE STILL AMPLITUDES OF 0.1 DUE TO THE RAMP OF ILLUMINATION.

** THE NEXT HIGHEST CHANNEL IN BAND 5 IS CHANNEL 9 WITH A PEAK NOISE VALUE OF 0.36 AT 9144 Hz.

BRIGHT TARGET RECOVERY (3.2.9.12)

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TABLE SHOWS IN BAND RADIANCES FOR WHICH A RECOVERY TIME OF LESS THAN 4 IFOV DWELL TIMES IS INSURED. RECOVERY FROM LARGER SIGNALS TAKES 10 IFOV DWELL TIMES (TYPICAL).

WORST CASE NUMBERS ARE BASED ON A THEORETICAL ANALYSIS OF THE PREAMPLIFIER ELECTRONICS.

BAND	IN BAND BRIGHT TARGET RADIANCE ($MW/CM^2/STER$)		
	SPEC	TYPICAL AT 17°C	WORST CASE AT 12°C
1	2.0	7.9	6.0
2	4.5	6.2	4.7
3	2.9	4.6	3.5
4	5.0	5.1 *	3.5 *
5	1.3	14.2	10.7
6	330 K	—	500°K
7	0.8	8.5	6.4

*BASED ON PREAMPLIFIER GAIN

SPECIFICATION COMPLIANCE SUMMARY

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ALL REQUIREMENTS HAVE BEEN MET (WITH THE FOLLOWING EXCEPTIONS)

- THIRTEEN MAJOR WAIVERS THAT AFFECT SYSTEM PERFORMANCE HAVE BEEN SUBMITTED, TEN APPROVED

- OPEN ITEMS

  - WAIVERS HAVE BEEN SUBMITTED FOR SPATIAL COVERAGE AND OUT OF FIELD RESPONSE.

  - WAIVER HAS BEEN SUBMITTED TO DELETE TEMPERATURE TELEMETRY FROM TELESCOPE BASEPLATE.

  - BAND 5 CHANNEL 10 PROBLEM IS BEING CARRIED ON AN OPEN FR.